JOURNAL

OF THE

Royal United Service Institutic

WHITEHALL YARD.

PUBLISHED UNDER THE AUTHORITY OF THE COUN

VOL. XII.

LONDON:
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39, CHARING CROSS,
NEAR THE ADMIRALTY AND HORSE GUARDS.
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Kitchener, H., Lt. and Adjutant 2 Batt. 6th Regt.
Plummer, H., Capt. 1st. Batt. 7th Royal Fusiliers
Waller, G. H., Major 2 Batt. 7th Royal Fusiliers
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Robertson, Alex. C., Col. 2 Batt. 8th King's
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Bancroft, W. C., Lieut.-Col. 2 Batt. 16th Regt.
MacGregor, H. G., Lieut. 1st Batt. 17th Regt.
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Hogarth, J., Capt. 43rd Light Inf.
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Parish, H. W., C.B., Lieut.-Col. 45th Regt.
Lowry, R. W., Col. 47th Regt.
Adams, C., Col. 49th Regt.
Lock, A. C. K., Lt.-Col. 50th Regt.
Peel, A. L., Lieut.-Col. 52nd Regt.

Bell, C. J., Lieut. 53rd Regt.
Bayly, V. T., Capt. 54th Regt.
Bellamy, P. L., Capt. 55th Regt.
Garsia, M. C., Lieut. and Adjutant 56th Regt.
Douglass, A. K., Lieut. 57th Regt.
Shipley, W. D., Capt. 58th Regt.
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Barker, G. D., Major 64th Regt.
Blewitt, C., Capt. 65th Regt.
Lamprey, Jones, M.B., Surgeon 67th Regt.
Bagot, G., Major, 69th Regt.
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CONTENTS OF VOLUME THE TWELFTH.

APPENDIX.

The Journal
OF THE
Royal United Service Institution.

Vol. XII. 1868. No. XLVIII.

LECTURE.

Friday, January 17th, 1868.

Major-General the Honourable JAMES LINDSAY, Vice-President, in the Chair.

UTILIZATION OF THE SOLDIER'S UNEMPLOYED TIME—A PROPOSED SCHEME INDEPENDENT OF GOVERNMENT SUPPLY; ALSO A PLAN FOR REGIMENTAL CHARITIES.

By Captain Sloane, Sherwood Foresters Militia.

Now, when it seems probable that for many years to come, peace has settled on the British Army, and that our soldiers have no greater object to look forward to than their daily drill, appears a propitious time for considering the means that are being adopted into the Service for the occupation of the soldier's unemployed time. The improvement of the moral and social condition of the ranks has been, and is, an anxious subject with the authorities; and although many good minds and exalted intellects have given much thought to the matter, yet it has but recently arrived at any practical movement. That the British soldier in time of peace leads the least profitable life to himself and the state, cannot be denied; and that hitherto his unoccupied hours have been spent in vice and recklessness, must be acknowledged with regretful concern. The healthy and energetic years of youth have been too often frittered away, and at a mature age, when habits are confirmed, the soldier returns to civil life, generally without a pension except a temporary one and with at most sixpence, and in rare instances a shilling a day, to begin life again upon, and to seek a new employment for, too often, shattered energies, and a broken constitution; therefore not only the military community, but the nation at large are interested in the subject.

The soldier may be regarded from two points of view. The first, in time of war, when his feelings are aroused, his mind is filled with

thoughts of military glory, and his heart is expanded with a noble and chivalrous love of country; the second, in time of peace, when his sympathies are relaxed, when enthusiasm ceases to animate, when, with the exception of the routine drill, his life is wasted in a purposeless existence. I propose confining my remarks to a consideration of the soldier from the latter point of observation.

To investigate properly the subject before us, we should enter into an inquiry into the habits and condition of the soldier at home, and of his life outside the barrack gate; but I am afraid that that had better not be examined too closely. This remark may seem to bear severely upon our men; yet in reality it is not so, for we must candidly admit the fact, that, owing to our system of military organization, the soldier is nothing more than the machine we make him. We have modelled the soldier in our own mould, but is it just that we should think only of rough casting him for one purpose? Having shaped him out as a material of war, ought we to totally neglect the formation of his moral and intellectual character, exercise no consideration or care except for his fighting qualities, and in every other respect of his existence,

"Let him down the winds to prey at fortune."

I venture to ask this question—Have we been so completely preoccupied in equipping him as an arm of the service, that we have forgotten that he is a human being?

As ours is a country of free enlistment, where the inducements to become a soldier are of a doubtful nature, we are unable to draw into the ranks other than the poorest portion of the population. We have not the aid of conscription to obtain a leaven of the middle classes of society, consequently the raw material of our Army is composed purely and simply of the sons of labour—men whose father's lived by the sweat of their brow, and who themselves were born to no fairer heritage. Thus we get the recruit accustomed to work, and for the first six months we give him plenty of it. The change of life, and the training in his new duties, together with the intellectual contact to which he is exposed, tend to sharpen him in a wonderful degree, so that when he leaves the care of the drill-sergeant, he is fifty per cent. a better man, and enters on his future career full of hope. This would be the proper time to open to him the advantages of his adopted profession. It will clear the way better for what I am about to introduce, should I briefly sketch the soldier from that period.

The soldier joins his company full of energy, cherishing visions of a bright future; but gradually these dreams become clouded, and fade into the fleeting past. The mind, which is at first expanded, sinks into the narrow channel of routine; for, having thoroughly mastered his discipline, he becomes wearied of its continual repetition, for authority repeats it three times a day, in a vain effort to provide him with an occupation. There is no employment for his spare time, and his abilities, be they great or humble, are pent up within himself. But nature must have an outlet. The plant which is not properly trimmed will

run to seed. Thus the young soldier is engrafted with the vitiated habits and associations of his comrades.

The inquiry is naturally suggested, why do the rank and file of our Army happen to be in this condition? The answer is this—because, the supply of men is obtained from the most uneducated and indigent classes. In time of war we have frequently had all the bad characters of our gaols and prisons emptied into the ranks; and these characters, of course, have endeavoured to force their bad habits upon their better-conducted comrades. Moreover, civilization, or what is termed the march of intellect, has failed to reach the soldier, or break through the cordon which his profession draws around him. Another great source of evil is the large amount of time during which the men are left completely to their own resources, the infantry consuming in barren idleness nearly one half the day. Again, how are the soldier's evenings occupied? As a rule, you seldom see the soldier in a place of legitimate amusement. Look at the galleries of a theatre, look at the back seats of a concert room—how many red coats dot these assemblies? The nets are spread to entice and entrap him long before the soldier can reach any place of pure entertainment. The gin palace and the beer-shop are close at hand; seldom can the soldier move ten paces outside the barrack gate without encountering a skittle alley or a tap-room. We are bound to acknowledge it—the soldier is a reckless, unthinking creature; but we are bound to acknowledge also that the fault lies at the door of our own administration. We give him no opportunity for improvement, no subject with which to steady his mind, although we undertake to morally guide him, and to provide for all his necessities. So entirely is he concentrated within his own circle, that all greatre forms and measures for his benefit, to be successful, must develop and work their influence completely within that circle.

The subject I am about to introduce, is nothing new; it is simply an endeavour to collect scattered instances which, having been great successes in particular cases, are now shaped into form, and submitted as a system. What I propose, is to organise a plan in each regiment whereby every industrious soldier may be provided with the means of occupying the hours not engaged on duty with such employment as would be adapted to his capacity, and remunerate him for his labour. If this were the case, a man would lose nothing by enlisting. The skilled artisan, the mechanic, and the tradesman, would not fear the pecuniary loss they now incur by entering the Army.

This subject, which at various times has been mooted, never seemed to meet with anything like a satisfactory solution until in this theatre a most able and ingenious lecture was delivered in April, 1864, by Lieutenant-Colonel Synge, R.E. That officer however confined himself wholly to Government employment of the troops, as the title of his remarks will show—"Military Work by Military Means." Colonel Synge went elaborately into the matter, pointing out the saving that would be effected if Government employed soldiers at fair wages for the construction of forts, fortifications, and military work in general, and laid down such principles as he deemed would be required for such under-

takings. That branch of the subject having been so ably discussed, I shall merely recommend to those interested, a reference to No. 32 of the Journal of this Institution.

There are numerous other branches of labour besides those to which Colonel Synge referred naturally embraced within the description of industrial employments, such as the manufacturing by the men of their own outfitting materials and their own clothing, the repairs of barrack damages, gardening, &c. Were the regimental mechanics allowed to repair barrack damages, a great source of heart-burning in the Army—the stoppages for barrack damages—would be dried up. But many of these employments, I am afraid, would interfere with the interests of the contractors, and we know from experience that that is not to be done with impunity.

However, I pass these subjects without further notice, and restrict myself to the one object, namely, the profitable employment of the soldier within his barrack.

I propose to establish a system thoroughly independent of supplies from Government, or, in fact, contributions from any source. The reason that every plan for utilizing the soldier's time has hitherto fallen through, is that all these efforts have been based on the supposition that the money should come from Government; and it is probable that the War Minister himself would experience as much difficulty in the House in obtaining the adoption of such a measure, as the Chancellor of the Exchequer recently felt in his struggle to finally settle the compound householder.

No doubt a great deal has been done lately, and is being done now, for the soldier's welfare; we have established recreation-rooms, amusements, and classes of instruction of various kinds. At Aldershot, for example, during the last six winter months, 284 entertainments were given, consisting of 209 lectures. 33 concerts, 34 readings, and 8 theatrical representations. Libraries and schools have also been established, though, I am sorry to say, the attendance at the latter has been little more than nominal, for out of the 11,000 infantry soldiers whose names are entered on the school list, the average attendance of each man has been but once a week, notwithstanding all school fees were abolished four years since, as an inducement. The great majority of our soldiers are uneducated, and one-fifth of them can neither read nor write; but although this educational poverty exists, there is not nearly the same deficiency in skilled labour; for examining the previous occupations of 1,000 men, we find that there are 250 mechanics and tradesmen; 132 manufacturing artisans; 106 shopmen and clerks, 7 professional men and students, the remaining 505 being labourers, husbandmen, and servants. Thus, we may say, in round numbers, that there are 400 skilled workmen in the Army, against 600 unskilled, so that if employment could be obtained by the soldiers, something less than one-half the men in the ranks would be able at once to select work of a remunerative character, which they could commence without delay, and by which they could earn good wages.

The fact is, the soldiers want to get started; it is there that the difficulty rests, because there is no guidance, nor direction, no means of

obtaining work, no money to purchase tools to work with. It is obvious, then, that we requre some principle on which to begin.

In order to overcome this preliminary difficulty, I propose to establish in every regiment, to direct the management, and to assume the whole control and responsibility of his department, exactly on the same principle as the Instructor of musketry, an Officer-Superintendent, or manager, who may be called the Officer of Industry. As this officer would require peculiar talents and qualifications, totally independent of his military proficiency, I would suggest that the selection should be made by the Field Officers of the regiment assembled as a board, or at least that the officer selected should be recommended for the appointment in that manner. But I may be met with the question —how are you to remunerate this officer? That I shall answer presently. Well, the Officer of Industry having been appointed in the regiment, how does he proceed to work? He reflects, and finds his first thoughts troubled with the great every-day want of the world; that which we live for, work for, fight for, and die for—money. Money is the mainspring of enterprise, and without this mainspring the Officer of Industry will be unable to set his machinery in motion. But he has a large field to work upon, which only requires careful management in order to produce an abundant supply of means for his purposes.

I may be pardoned the digression I here make, in referring to the passing of the estimates for the Army in Parliament. When the Minister of War proposed a grant of £2,000 for the purchase of billiard tables, and the erection of billiard-rooms in barracks, to enable officers to find amusement at home—a grant for which the Service is deeply grateful to him—I have no doubt that had any of the many military members present reminded the Right Hon. Gentleman to set apart a similar sum for the establishment of industrial workshops in barracks, he would probably have acceded to the request, and Parliament have voted the money unanimously.

The means by which the Officer of Industry can obtain money to start his workpeople are various and endless. Nothing is easier than for a regiment to get up an entertainment, whether in the way of field sports, amateur theatricals, lectures, or concerts; in fact we have only to turn to the pages of the military newspapers to see how frequently these performances are given. Every regiment can draw out an attractive programme of field sports, such as athletic feats, prowess of arms, &c. The men who take part in them would be satisfied with small rewards, considering the object and the fun. Then the services of the band would cost nothing, and the printing could be done in the regiment, as every battalion has, or ought to have a portable printing press. Very little expense would be incurred, and almost the whole receipts would accrue as profit. Only in very small country towns where regiments are quartered, would it be impossible by a first exhibition to realize a sum of twenty pounds. I need not call attention to the fact, that garrison amateur performances always draw crowded houses. The public are extremely fond of military music, the band being almost a sufficient attraction; there is, also, the influence of officers amongst their friends to be taken in the account. Another

important consideration—at least with the ladies—is, that military entertainments are fashionable affairs. I say, then, let them be made paying speculations. If in preparing for concerts, or lectures, officers devote a large portion of their time to studying music, or reading up scientific subjects, and junior officers are thereby drawn away from amusements less intellectual, it might be to the advantage of all parties concerned. Persons who have not given the subject consideration may be dubious about the success of such undertakings, or, perhaps, may not be aware how easy a matter it is for a regiment to get up a capital concert. However, having some experience, let me briefly sketch a programme. The band occupies the orchestra, commences with an overture, following with an opening chorus, a few solos being selected for the best instrumentalists; then it is always easy, from seven or eight hundred men, to get some good voices for songs, glees, &c., with an occasional introduction of the comic element, which always goes off well. Here is a well-paying venture—all profit. Other very creditable and profitable undertakings are exhibitions of industrial works; nothing could be more successful, than a display of the kind given by the second battalion of the 12th Regiment at Dublin. The Rotunda—a large public building in that city, was crowded with specimens of work from nearly every branch of trade; and all through the halls, men were employed at their benches—not mere amateurs, or jobbers—but regular mechanics who, from their excellent workmanship and practical manner of handling their tools, would never have been supposed to be soldiers, but from their undress uniform. Nor was the honour of the exhibition left completely with the men. Their officers competed with them at every stall, some with paintings, drawings, photography, finer pieces of workmanship, collections of curiosities, and inventions. On that occasion were exhibited experiments with signal lights by one of the officers, Captain Bolton. Captain Bolton's invention was patented, and I am glad to find that it since has been adopted by Government.

I have been a little lengthy in description, but have dwelt on these details to show the advantage that would arise from such matters, and to prove that profitable entertainments are perfectly practicable speculations.

Let us suppose, now, that an Officer of Industry is appointed to a regiment. I think it would be fair to assume that he could easily become possessed of from £20 to £50, at the very least, by some of the plans I have referred to. With that sum I can point out a dozen different branches of industry, with tools for which he can provide his men, and all of which will return quick profits.

Turning to the question of the workshops. If the authorities make a move in this matter, undoubtedly they would issue directions to the barrack masters to provide suitable places, and, although a regimental officer may be cooped up in a pigeon-hole, and his expostulations be met with an answer of "want of accommodation," yet it is tolerably certain, when the barrack people receive an order from head-quarters, that, by perhaps personal inconvenience, they can find room for anything. But the Officer of Industry can be quite independent of assistance, as there are generally spare stables, and all he would require

in winter would be, to provide a couple of portable stoves, lay on the gas, and go to work. Piece-work of different kinds, of course, men could do in their own rooms.

Workshops provided, how would the Officer of Industry find his people employment? By the same channel that all establishments of the present day obtain their customers, that ready means of communication, advertising; and the men, for their own benefit, will keep a sharp look out for jobs; in fact, there can be no difficulty, as he goes into the labour market enabled to outbid all opposition on the part of those who have to feed, clothe, and lodge themselves. Nor will there be anything more easy than taking in work, as each branch of industry will have its own foreman, on the same principle as the master tailor, or the armourer sergeant, who will be answerable for all material received. With regard to employers, they will feel every security and confidence in dealing with responsible parties, whose position will be a sufficient guarantee that the work will be carefully and punctually completed. The feeling of interest for the soldier, or latent sympathy, which, though unostentatious, strongly prevails through the nation, will be brought into action, and without doubt work will be offered so abundantly, particularly as it will add to the employers' pecuniary benefit, that we need not fear any want of success on that point.

As before shown, more than one half the men are unskilled in labour, these men would therefore require to serve a kind of apprenticeship; and to a man who has been accustomed to work of some sort, there are numbers of trades that could be easily acquired in one year. During that year of learning, the unskilled soldier should be under the foreman of his branch of industry, and, of course, should recompense him for teaching the business. A fair payment for all parties would be, to allow his instructor one-third of his earnings for the first twelve months. Thus, in the course of a few years, nearly every man in a regiment would become acquainted with some handicraft, which would, *for ever* after, enable him to earn a living, either with or without connexion with the Army, or in any part of the world.

There should be one uniform system of accounts used in every battalion, as it would simplify and render intelligible all transactions. I have drawn out an industrial ledger, on a similar principle to the companies' ledger now in use, which is being printed, and will be laid on the table of the Library of this Institution for inspection. It will show, at a glance, how every man's accounts stand, and can be kept by a non-commissioned officer clerk, who should be paid out of the funds. Thus, the Officer of Industry is relieved from all personal trouble, except the superintendence and direction; the appointment would be honorary, and to any officer who cared for the service, a labour of love.

There would always be money to the credit of the Officer of Industry, accruing from two sources, first, the repayment of all moneys advanced to men for materials, or the purchase of tools, &c., which would then become their own property; and secondly, from a deduction of ten per cent. on their profits. This would meet all contingent expenses, such as the payment of the clerk, lighting, hire of machinery, and transport

of goods. By this means the system would not only support itself, independent of Government supply, but there would always be money ready to contract for work, or to purchase materials. The fund should be allowed to accumulate, nor should there ever be any division among the operatives, as the savings they could acquire at the time of the expiration of their period of service in the Army, would be to the industrious, quite satisfactory. By my plan of combining the profits of amateur amusements with the industrial profits, there would always be an increasing fund, which should remain in the regiment never to be broken, except in a case ofcharity, such as relieving the poor widow of a soldier who had died *in* the regiment. For such a noble purpose, a soldier would never grudge ten per cent. out of his earnings, as, in fact, it would only be the interest on money borrowed from his industrial bankers. Without troubling my audience with figures, I may say, that in the course of a dozen years the deposits in each regimental Officer of Industry's hands, might amount to hundreds of pounds; thus many a deserving soldier's widow could be rescued from poverty and the temptation to an evil life, which besets a destitute condition, and placed in a way of supporting herself and family, so that, in time, the fund might become one of the special charities of the Service.

The last part of the scheme I propose to establish, is the most important, viz., the appointment of an Inspecting Officer of Industry; and here it would be necessary to make a slight call on Government support. One officer would be sufficient for the duty—I am always speaking of the troops at home—he could make his tour of inspection to each regiment, aiding the Regimental Officer of Industry with his advice, examining the books, and regulating the general carrying out of details, giving lectures to the men on the subject, and organising the system in regiments on their arrival from other countries, and, of course, making his return for the information of the Commander-in-Chief. A popular man would be best suited for this position, one who could get up an entertainment, or give one, and who had a general knowledge of trades fitted for soldiers. The pay of this officer and his travelling expenses would not exceed £600 or £700 a year, so that at a cost of, say, £800 to Government—which might easily be afforded from the surplus of the Army Estimates—every soldier, during the ensuing winter, could be happily and profitably employed. Is not this a matter for serious consideration by those vested with authority?

With regard to the time soldiers could devote to industry. A mechanic's day for labour, deducting the usual allowance for meals, varies from eight to ten hours; this may be averaged at fifty hours' work for each mechanic, weekly. Now, in summer, or the drill season, if so inclined, a soldier could snatch from his spare time or intervals between his duties, eighteen to twenty hours weekly, or something equal to two mechanic's days; while in winter, when the afternoon parades could be dispensed with, a soldier might make time equal to nearly four whole mechanic's days. This would give the Commanding Officers of regiments a desirable opportunity for granting indulgences to well conducted men, as, on the recommendation of the Officer of

Industry, they could be given leave from these parades; only such names to be returned as were steady men, and found to be investing their earnings in the regimental savings bank, or otherwise properly applying them. This would be a better means of conducing to the good conduct of the Army, than the present attempt to bribe by good conduct stripes and a penny a day. It would be a considerable check to a man misconducting himself, to be suspended from entering the workshops, and to have to return to his afternoon drill.

The amount of money earned would, of course, be affected by various influences, including the class of the work, and skill of the workman; but suppose the mechanic makes 4*s.* a day, or 24*s.* per week—a very low estimate—and the soldier can make two days per week in summer, and four in winter, allowing one day per week for guard-mounting inclusive, quite as often as that duty should come; we find he could make over £30, but say £30 a year, and I believe I am not overstating it. This would in time increase to a tolerable sum.

There are persons who cavil at every innovation, and these persons might say, "This is all very well; the soldiers at first would work pretty constantly, but they would soon tire." To this I would answer, "You do not frequently find people tire of receiving or making money." The soldier is not naturally so careless and improvident as he is represented. He always has some glimmering thought of what is to become of him when his time expires. Look at the regimental savings banks, what numbers have hoarded their little sums; but if in too many cases they are reckless spendthrifts, it is because they grow impatient of adding little fractional sums—pence and pence—that almost amount to nothing in the end. But give him the opportunity of accumulating by his own exertions, and see how perseveringly he will roll along his own snow-ball. The mechanic is obliged to spend his money as he earns it; the soldier would have greatly the advantage of him, for he could view his savings daily increase with that most gratifying feeling, that he did not require to put his hand in his breeches pocket.

Having now submitted how this scheme could be established, having also explained the internal working of the plan, and the objects in view, we may proceed to an investigation of its merits; to examine the advantages or disadvantages to Government and the country, to our own military system, and to the soldier.

For the Government, it would solve the problem now found most difficult, namely, that of recruiting, and it would relieve anxiety about the wide gap in the ranks caused by the want of some eighteen to twenty thousand men. What prevents enlisting? It is not want of chivalrous feeling; but in these money-making days, young men are generally cautious. They are aware that enlistment means the investment of their capital of labour, in the lowest remunerative market. The consequence is, that the recruiting sergeant's eloquent harangue and beer are both lost, for he never can get over the fact that the recruit can earn twice the wages at any other occupation. But you grasp the vital part of the subject, when you offer to the recruit, better opportunities of acquiring money as a soldier, than as a civilian, and when

you make it clear, that instead of a man's abilities being lost, for want of use in the Army, he has greater facilities for using them. In fact, by holding out the inducements suggested, you compete in the labour market, which is in reality the gist of the whole difficulty—and outbid the civil employer by offering higher wages. Here, also, is an answer to the continual exclamations of the magazine writers, "give us a better class of men," for we should then obtain an abundant supply of such recruits as we seldom get now,—healthy, well educated young mechanics, artisans, and tradesmen.

I have considered carefully what objections Government could make to the employment of the soldier, and I can see but two: firstly, the supposition that the state would be called on for money; secondly, the fear of losing the ten years' service men; but as I have already shown, the system is self-supporting, and could not possibly involve a greater outlay than the pay of the Inspecting Officer of Industry, which would be of course a mere trifle. I deem the first objection too insignificant to require further argument. As to the loss of the ten years' service men, may I ask how many can be possibly induced to stay in the ranks now? Unfortunately very few indeed, so, that at the most, Government cannot be worse off than it is at present. But if the soldier be making money, and at the end of his ten years, finds himself in possession of one or two hundred pounds, and if you offer him inducements for his second period of service, with the opportunity of doubling, or perhaps, tripling his capital, then the mere love of money alone will probably influence him to remain. If a man devotes a portion of his life to the acquisition of money, it becomes the great object of his ambition, the passion feeds itself, the man longs to see his one hundred become two hundred, even as the millionaire keeps still in business to make his second million. Thus, the soldier will calculate upon retiring in comparative luxury and ease; the means of attaining which, no other manner of life could have given him.

With regard to recruiting, I should not wish to offer any suggestions, but as it comes in contact with my own subject, I cannot avoid making a few remarks. I would propose:—

1st. That a bounty of £5 or upwards be offered to the recruit at the time of enlistment, additional, if he agreed to serve the full time of 21 years.

2nd. That the recruiting sergeant or bringer, should get 5*s*. additional for every recruit so attested.

3rd. That it should be open to every soldier (approved of) to re-attest at any time during his first ten years' service, and that he should thereupon receive from his Adjutant the re-attesting money.

4th. That every soldier during his second period, should have but one parade each day (except in case of punishment) during the winter months, the other parades being substituted by roll calls.

5th. That all soldiers whose time was occupied with the consent of their Commanding Officer—such as in workshops—should be excused from these roll calls.

6th. That every soldier at the completion of his 21 years' service

should be entitled to a pension for the remainder of his life, equivalent to the pay he was receiving at the time of his discharge.

Were these inducements offered we might not—as many writers now do, through a large number of the ten years' service men's time expiring—contemplate wanting forty thousand men, nearly a fifth of the Army in 1870.

Colonization is another important matter for the consideration of the Government, as the soldier settling in distant lands spreads a feeling of loyalty among the inhabitants and attaches them to the mother country. There can be no such acceptable colonist, as the man accustomed to military regularity, trained to industrial pursuits, with a good knowledge of a trade, and a fair capital ready to invest, to give himself and family a stake in the country of his adoption. By this means, when the period of service expired in the colonies, the men would settle there, saving the expense of shipping home, which is no inconsiderable sum from distant places like India, whence they now frequently return to become a burden to the poor rates, or throw themselves on the generosity of their more prosperous civilian friends.

Desertion would be unknown in the ranks; if these workshops were established, a large sum would be saved annually, as no man with an opportunity of earning money, and with a goodly sum to his credit, would ever be willing to run away and leave all behind.

Now, looking at the effect on our military system, what objections could be advanced against this proposed plan of employment? It might be suggested that a sense of independence, from the possession of money, would injure the machine-like working of the ranks, making the men less subject to control. I mention however that the discipline of the Service is too perfect to be impaired in that way. Having a sum in the savings bank, can never tend to lessen a man's fighting qualities as a soldier. As a proof of this I may mention that no aspersion was ever cast on the gallantry of our officers, who, until the recent introduction of competitive examinations, were all drawn from the opulent classes of society. I think it will be conceded, therefore, that under that head there can be no objection.

To the soldier, the advantages of this proposal to establish workshops are so numerous that I shall only mention a few in which the country and the army generally are alike interested. In the first place, the health of the troops would be greatly improved, and the mortality among them very much lessened; for though the comparative statistics of civil life in different nations show the British Isles to be one of the most eminently healthy regions of the world, yet home to our soldiers is more fatal than foreign stations. The average number of men constantly sick is far greater in the United Kingdom than in any of our vast possessions, with the exception of India, China, and Ceylon, and the death-rate here, where we have camps and barracks to perfection, very much exceeds the deaths abroad. I need not say that this is a matter of vast importance, inasmuch as each soldier of the line costs about £60 by the time his training is completed. There can be no doubt that the great amount of sickness and mortality principally arises from the dissipation the men are driven to, rather than sit un-

employed in an empty barrack-room. Is it not a fact that the Corps of Royal Engineers has a smaller average of sickness in it than any of the infantry battalions, and that the men are also better conducted and more trustworthy? Does not this speak eloquently for an industrial body? The fitness of the soldier for employment is further exemplified by the public confidence placed in that excellent corps—founded by Captain Walter—the Commissionaires. As for ability and willingness to work, we must also take the Engineers as an example, for we have no other troops where trades are recognized, and we find that Government by employing one of these corps, instead of an equal number of civil workmen, saves a sum of £600 yearly.

A most important consideration is, what bearing would this question have on the marriage of the men? I do not suppose it would cause any sensible effect, nor would there be necessity for changing the already existing regulations, but those men who did marry would have a means of provision for their families which would not cease when their regiment went to distant colonies, as they could transmit their earnings, which no doubt would be greater there than here.

With regard to the wives who are now left behind, the public is, unhappily, too well acquainted with the state of destitution and its consequences into which these young women fall. Not being able to receive pecuniary assistance from their husbands, and being frequently unable to provide for themselves, who can blame them if they sink into deplorable misery, degradation, and immorality, so that on the soldier's return all ties of his former married life are obliterated? Can there be any picture more painful? The gallant and faithful soldier returning to his home, finding himself utterly bereft of the wife he loved so dearly, and of the baby he had hoped to see a man.

To the reflective mind this alone is a sufficient reason for welcoming a means that seems particularly calculated to alleviate this crying evil.

Altogether the subject is so vast, and admits of so much being said, though I have rigidly restricted myself to its proper limits, that I find great difficulty in keeping within reasonable bounds, yet I must briefly again refer to the Regimental Industrial Charity Fund.

The plan of combining the profits of amusement, and the ten per centage on the labour profits, would yield a good sum yearly, which could be banked, as it is probable that the Industrial Department would, after a time, float itself without advances, the men becoming possessed of sufficient means of their own for the purchase of material. This reserve fund, in the hands of the Officer of Industry, being exclusively devoted to regimental charitable purposes, would form, not a mere nucleus, but would develop into an important and popular institution of the Service. Look at all the sums that now go wandering about, that would be drawn within its beneficial influence. Officers who have retired, and whose memories carry them back to old associations, would remember it in their wills; officers on joining, or leaving, would make presentations; all regimental fines might be paid into it; men who had lost sight of their friends or had no relations—whose heirs we see so frequently advertised for in the papers—if they died in the regiment

would leave it their accumulated savings. The ladies of the regiment could hold annual bazaars, and collect fancy works, and men and officers, also, could send in their contributions; the soldiers' wives might be employed in making articles, and be paid for their time, so that every regiment could have its yearly fête in aid of its charity. I think I might venture to say that we should witness on all sides an honourable rivalry to increase the funds. The lectures, concerts, and amusements, that would originate for its benefit already alluded to, would afford a healthful and intellectual employment for the officers.

Before concluding, there are a few plain questions I should like to place before those who have honoured me as an audience.

Do you consider these regimental charities practicable, and should they be instituted?

Do you consider industrial employment should be established?

Do you consider that the best means of organisation is by the appointment of an Officer-Superintendent in each regiment, as suggested, on the principle of the Officer of Musketry?

To show the immense expense involved in shipping home men whose first period of service expires in distant colonies, and who refuse to renew there, though they frequently re-enlist at home, I may quote an extract from the evidence given by Lord Strathnairn, when examined before the Recruiting Commission. He states, "the great majority of men whose first period of time terminates in India, return to England; during the last year of my command 2,000 came back, and the cost of sending home these men, and sending out substitutes was so great that the Government of India had it in their consideration to give them a very large bounty, as much as £40, as a matter of economy. There is a general feeling among the men that their increased usefulness during their ten years' service is not acknowledged. I hear that this is the case from officers of a benevolent disposition, who are in the habit of mixing a good deal, and making themselves acquainted with their men. . . . I enquired from Colonel Dillon, Rifle Brigade, what means to suggest to induce these men to re-enlist; among many recommendations, he said, if they were excused from certain parades it would be a great advantage, in all of which I quite concurred." Lord Strathnairn also advocated the employment of the men at trades.

If these afternoon parades are granted to the men during the winter months, it becomes of greater necessity to devise some means of occupying their time. It may be said there are the recreation-rooms, but it is impossible to suppose that soldiers can, or will, spend all their time in these rooms. Certainly it is right to take what is given and be thankful, therefore I shall not make the slightest reflection on this movement in the Service, but I would ask others to do as I have done, enquire into the attendance at these places. In some instances men have what is termed an opportunity for working at their former trades in the recreation-rooms; but is it to be conceived that the soldier, who is in general so thoughtless, can sit down to work in the next apartment to a billiard-room or bowling-alley? And how is he to get work, and who will supply him with money for material?

If the authorities can find sums of money to expend in providing these places of amusement, why not go a little further, and provide the means of lucrative employment? The nation is increasing in wealth through her trade and industry, and why deny to the soldier the right to participate in the general welfare?

There exists no feeling of doubt that this disposal of spare time would in any way interfere with the soldierly habits, or *esprit de corps* of the Army, for very little consideration will point out that the industrial employment of the French troops never cools their military zeal, which is proverbial. I have refrained from alluding to the industrial departments of continental armies, as it already has been referred to in this Institution by Sir Harry Verney.*

There is one topic more. How would this interference with labour be received by the working classes? Undoubtedly they could not see any plausible objection, as labour is a right divine, and the market is free to all. The foreigner from every nation is welcomed to join the ranks of toil, and there are now few work-rooms in our largest towns that can be entered, without hearing some of the *employés* conversing in foreign languages. When these strangers are so generously received, how much more welcome to the English mechanic will be the soldier, the defender of the nation, and his brother countryman, to compete with him in the sturdy occupations of industry?

As the aspect of affairs throughout the world does not show any probability of our troops being engaged on active service—for we can barely look on the Abyssinian expedition as a matter of importance, with respect to fighting, when in all possibility it will never meet with an enemy—it is likely that regiments may attempt to get trades to work, but that has been frequently tried already, and did not meet with the success it should have done. The reason is, that the subject requires to be placed legitimately before the public, as an acknowledged and authorized system of the Army. It is necessary to have a proper head of the department in each regiment, with whom manufacturers could at once communicate, and in whom they would feel confidence, for assuredly employers will not part with their material until certain of its safety. It is plain by the current of public opinion, and the sentiments expressed by His Royal Highness the Commander-in-Chief, at the opening of the Guards' Institute, and also by the Secretary for War, that we may expect soon to see some initiative taken. The ensuing season may witness the soldier's highest hopes realised, and the different barracks and camps through the country filled with employed and happy men. Then may we look forward to a new era for the army—the soldier a changed being; an intelligent, thinking, trustworthy, sober, steady, well-conducted man who will no longer require any semblance of the lash; and as the State treats him well, and, above all, employs his mind, so will he give, from respect and love to the Service, what he now does from fear. Then shall we find a rich and expectant soil, in which to sow the seeds of Divine truth; then our many religious societies, all of which labour so zealously for the

* Journal, No. 32.

reformation of the soldier, will hail with pleasure a movement which so facilitates their good work; then shall we rescue the soldier from the haunts of drink and vice, training his mind to industry, and the better feelings of human nature, thereby preparing him to receive the great revelations of Christianity. But without some little assistance from Government, any attempt of this kind would be useless—and worse than useless—it would be a failure! As before stated, all movements to benefit the soldier *must emanate from within his own circle!* If this step for the improvement of the soldier's condition is ever to be taken; if these industrial employments are ever to be established; if we are ever to see shining brightly in the future, a beacon which will help to rescue the soldier's widow and his orphan, *we must first look for countenance to the highest military authorities.* Then, let this appeal be made, in the name of this good and noble charity—in the name of the so-called dissolute, idle, and forgotten soldier—in the name of the Great Giver of all charity—not to let want of consideration, or red tape, stand in the way of this most important subject!

Evening Meeting.

Monday, January 20th, 1868.

REAR-ADMIRAL SIR FREDERICK W. E. NICOLSON, Bart., C.B., Vice-President, in the Chair.

NAMES of MEMBERS who joined the Institution between the 1st and 20th January, 1868.

LIFE.

Gordon, Wm., Lieut.-Col. Bengal Staff Corps. 9*l*.

ANNUAL.

Rawlins, John, Capt. 48th Regt. 1*l*.
Sterling, John B., Capt. Coldm. Gds. 1*l*.
Stone, Cecil P., Lieut. 77th Regt. 1*l*.
Macqueen, D. R., Lieut. 75th Regt. 1*l*.
Alexander, G. G., C.B., Major-General Royal Marine Artillery. 1*l*.
Wood, Elliott, Lieut. R.E. 1*l*.
Leycester, E. M., Capt. R.N. 1*l*.
Ommanney, F. M., Lieut. R.N. 1*l*.
Hogarth, Alexander, Major 1st Aberdeen Rifle Volunteers. 1*l*.
Pinnock, Harris N., Ens. 71st Highl. Light Infantry. 1*l*.
Whish, C. F. D., Cornet 6th Inniskg. Drgs. 1*l*.
Cadell, R., Colonel R.A. 1*l*.
Browning, M. C., Capt. 87th Royal Irish Fusiliers. 1*l*.

EXPLOSIVE BULLETS AND THEIR APPLICATION TO MILITARY PURPOSES.

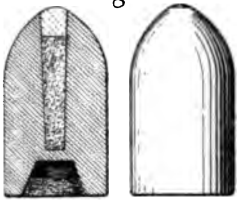
By Major G. V. FOSBERY, V.C., H.M. Bengal Staff Corps.

IN bringing before you the subject of to-night's lecture, I do so with the painful feeling that it is a very *dry* subject—indeed, one which may be instructive, but cannot be made amusing; I can only, therefore, express my pleasure and surprise that the uninviting nature of my title should not have prevented more from attending this evening.

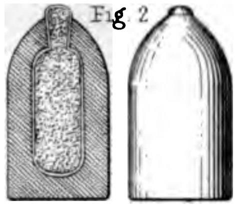
In treating this subject, I propose to show what an explosive bullet is; give some idea of its history and construction; its effects; and in what way it may be applied to military purposes. I shall notice the objections usually made to such a use of it, leaving each to form his own opinion as to the real position of the question of its rejection or adoption as a weapon of war.

An explosive bullet stands in the same relation to a military or sporting rifle, as does a percussion shell to a field or siege gun. It is, properly speaking, a *shell* calculated to explode on striking its object, and to give, whether by the shock or the flame of such explosion, effects different from those of the solid bullet.

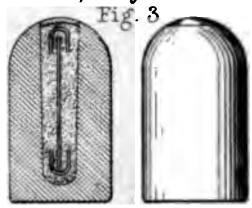
Metford
Fig. 1.



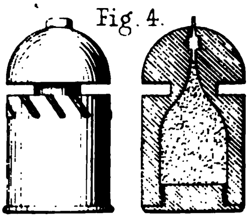
Copper Bottle and Sand Core Shell.
Fig. 2



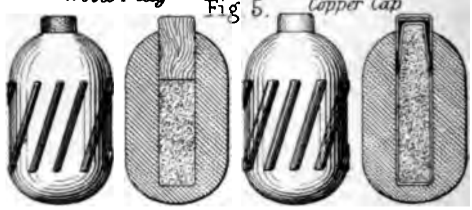
Lang
Sporting Shell
Fig. 3



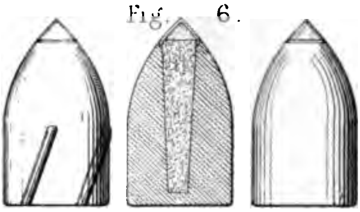
Systeme Devisme
Fig. 4.



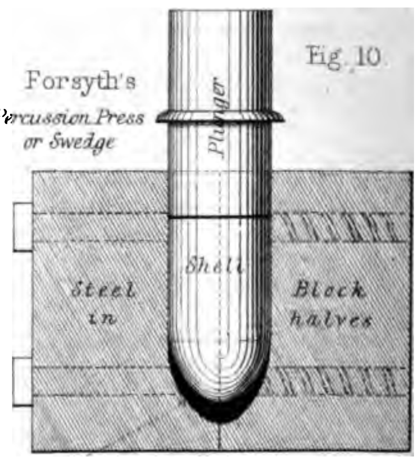
Norton
Fig. 5.



Jacob
Fig. 6.

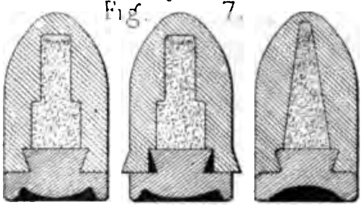


Forsyth's
Percussion Press or Swedge
Fig. 10

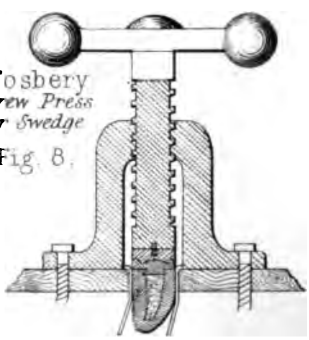


Cavity into which the Shell is rammed.

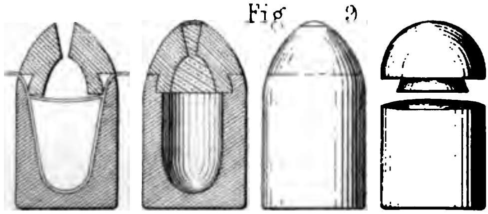
Fosbery Shell
Fig. 7.



Fosbery
Screw Press or Swedge
Fig. 8.



Forsyth's
Black Buck Shell
Fig. 9



J. Jobbins

For instance, an explosive bullet or *rifle-shell* (as we may call them, if it be understood that in doing so the RIFLE is to mean a rifled small arm), will prove almost certain death even to animals too formidable to be fired at with safety with a single ball. A rifle-shell will also explode gunpowder enclosed in stout cases, such as artillery limber-boxes at extreme ranges, and when an ordinary bullet would in no ways affect it. Further, the explosion of a single Enfield rifle-shell of large capacity can be seen and heard at distances of 1,000 or 1,200 yards; whereas the ordinary bullet gives no sign. It is on these properties that its usefulness depends.

Rifle-shell are already well understood and habitually used by most sportsmen who attack the heavy game of Asia and Africa; and to their growing use it is owing that accidents from the charge of the wounded buffalo, rhinoceros, tiger, and elephant, are becoming every day less frequent and less fatal. When they were first introduced into the sporting field, there were not wanting those who denounced their use as "not giving the poor beast a chance," namely, of devouring or demolishing the sportsman, whom they considered as taking a mean advantage of his game, and being rather a poor fellow than otherwise. But in spite of such remarks, the shell has been gradually improved, and this use of it, in some form, has become at the present time almost universal.

I think indeed that no really merciful man would condemn the animal on which he draws trigger, to a lingering end from a single bullet-wound, or to the slow torture of being shot to death, as were notably some of the elephants killed by Mr. Gordon Cumming; when he may if he pleases use an instrument which will strike it down as by a flash of lightning. Even though by doing so he should deny himself the pleasurable excitement of a charge, with perhaps the demolition of some unhappy beater. In the same manner we hear the use of rifle-shell in war condemned as cruel, cowardly, or useless. If I should succeed in raising a doubt as to whether it is in truth either the one or the other, at all events a step will have been made towards the dispassionate discussion of the subject, which is all one can hope for from a paper such as the present.

I will now, if you please, enter on the history and construction of these missiles, and pass on to their uses and the consideration of the validity of the arguments used against them.

The rifle-shell was (there is, I believe, no doubt) originally proposed and made use of by Captain Norton about the year 1826, and differed but little in principle from many of those in use at the present day. I have here one of his earliest explosive bullets (Plate I, Fig. 5); it is, as you see, mechanically fitted to a polygroove-rifle, rounded both in front and rear, and having a cylindrical hollow some three-sixteenths of an inch in diameter, reaching from its apex to within a short distance of the base. In this was placed some detonating powder, and a wooden plug inserted in the head, acted as a striker on the shell reaching its object. Another form carried a small tin tube, fitted into the hollow; this was filled with gunpowder and a percussion-cap placed on the end of the tube, produced ignition in like manner at the moment of impact.

The next great inventor of rifle-shell (Fig. 6) was General John Jacob, of Jacob's Horse.

A drawing of the shell of which he is the author is before you. In such a paper as this it would be impossible to do justice to the value of the experiments carried out, under every disadvantage of climate and distance from the centres of manufacture, by that extraordinary officer. Suffice it to say, that for *ten years* he carried on, at a vast expense, and solely on his own account, experiments on a scale that, till then, had scarcely been attempted by the small arms department of any Government; and obtained years ago, results which have been but rarely surpassed, even up to the present time. After having perfected a system of rifling and construction, both of weapon and projectile, he placed the results of his labours at the disposal of his country; adding, as he did so, that the rifle-shell, if properly understood and used, would one day prove the most formidable weapon of destruction ever invented by man.

We next have the Metford shell (Fig. 1), at first sight merely a Jacob shell, having its cavity filled with percussion powder, and the orifice stopped with wax. Those, however, who should so regard it, and therefore despise in their hearts this projectile as at present introduced into the Service, would do wrong. The detonating arrangement of the shell may itself be in appearance excessively simple, but it is also wonderfully effective. Simple as it is, it cost its inventor many thousands of experiments before he was able to render it both safe to manufacture as well as to handle, and certain of explosion. It was during these experiments also, that he discovered the method of so distributing the weights of the Enfield bullet as to improve its shooting some 20 per cent.; a discovery to which much of the accuracy of shooting displayed by our converted rifles is due. His shell was also the cheapest yet made, rendered so by the ingenious machinery by which the inventor produced them; this is now-a-days no small a consideration.

A shell invented by Colonel Boxer, of which I have unfortunately no specimen, was long tried against Mr. Metford's shell. It had the advantage of carrying a flame of some duration into an enemy's ammunition waggon, and was in this way exceedingly formidable; but was also, it is said, somewhat costly to manufacture.

The question of the adoption of a shell into the Service, was in a measure settled, when, in 1862, I invented the shell which you see here represented (see Fig. 1).

I was, as you will see, indebted to Mr. Forsyth, for the idea of forming a shell in two parts, as his so-called Black-Buck shell (Fig. 9) had been already figured and described in the "Field" newspaper. But as we were in search of different objects, a very different method of setting to work was necessary in both cases. Mr. Forsyth wanted a large shell of great interior capacity, for short ranges, and cared not for the trouble and inconvenience of its manufacture, or its inaccuracy of flight, beyond a hundred yards or so.*

* The method of charging and completing the Black-Buck shell was as follows: The lower portion was filled with gunpowder, and a patch of linen or calico placed over it. The upper portion was then forced in, and the two united by hammering

I wanted a military shell also of greater capacity than could be obtained by merely hollowing the head; simple and cheap to manufacture in large quantities; and accurate up to the longest ranges.

In order to gain penetration, and have the power of increasing that penetration at will, I made the head of solid lead, and loaded the shell at the base, a thing never, I believe, before attempted. To gain a proper balance, I adopted, after many experiments, this peculiar form of hollow; and for rapidity of manufacture, a tapered tube, through which, by a screw or otherwise, the shells could be thrust one after another, and so be quickly completed.

As you will see, therefore, this shell differed in many important particulars from Mr. Forsyth's, even in the method of forming the dovetail joint, which is, indeed, their only point of resemblance—and these differences were wholly mine. It took me next a whole year of experiment before I could get it to shoot. In 1863, at Mr. Forsyth's request, I forwarded him, through a friend, a sketch of my shell and apparatus, which had then just been favourably reported on by the Indian Select Committee, and in a correspondence which ensued, clearly pointed out the points of the invention, which I claimed as original. The question, as between the two shells, was, moreover, referred to Sir Hugh Rose, who at once recognized them as distinct inventions, intended for different purposes, and claiming notice on different grounds.

Mr. Forsyth was, however, then preparing for the press a work on "the Sporting Rifle and its Projectiles;" and although I was fairly warned of what I might expect from him, I confess I was a little surprised at seeing in his published work a wood-cut taken from my sketch, and entitled, without the slightest acknowledgment, one of the "modifications of which my shell admits." He has since, I find, wholly adopted that modification, and further given himself the trouble of re-inventing my screw swedge to make it with. I merely mention these circumstances, as many of you have, I dare say, seen the shell now often called the Forsyth shell, and might recognize it in the drawing, without being aware of its history and origin. Whatever merits it may possess as a military shell have been fully recognized by the Government of India, for which I was then working. For five years I have taken no steps to dispute with Mr. Forsyth his right to what he has appropriated; nor should I do so now, did I not think it my duty, when speaking of it in this place, to vindicate such claims as I possess to the invention. These I now submit to your judgment, and through this Institution to that of my brother Officers of the Services. Mr. Forsyth is wholly welcome to whatever credit he may have obtained from others by this conduct for an invention not entirely his own. I trust, in speaking warmly of it I offend no one present; for, indeed, I think every gentleman here will admit that reputation got in this way, is purchased at a price which he would himself be unwilling to pay for it.

in his swedge. They were then taken out, the upper compartment, filled with detonating powder, and stopped with wax, or a metal plug.—G. V. F.

The shell here shown (Fig. 2) is another which has also been proposed for both military and sporting purposes, by various inventors, and it may be called a copper bottle or sand-core shell, according as the lead is poured round the one or the other. You must see, however, that, in either form, it would be tedious or expensive to make in large quantities.

Fig. 3 represents an ingenious and handy plan of Mr. Lang's, by which any hollow-headed bullet may be converted into an effective shell. He inserts in the hollow a short wire, placing a copper cap on each end, fills the hollow with gunpowder, and stops it with wax; on striking the object one at least of the caps is certain to ignite it.

Next in order, though indeed perhaps its size and importance should have entitled it to an earlier notice, comes the shell of the *Système Devisme* (Fig. 4), invented by the celebrated gun-maker of the Boulevard des Italiens, who was good enough lately to fire several of the shell before me with wonderful effect, and has kindly lent me the arm, which you see here, by which to explain to you his system. His shell, as you will perceive, is an extraordinary-looking missile, and very different from what, in our ideas, looks like work. I have, however, seen letters from Jules Gerard and other French and foreign sportsmen of undoubted character, who speak of its extraordinary performances in no measured terms; and, indeed, from what I saw myself, I should be induced to think it, for sporting ranges, by far the most destructively effective shell known, owing to its immense explosive power.

We have thus far then treated of the explosive bullet or small-arm shell as to its history and construction. Some, it will be readily seen, are well adapted for the purposes they are intended to fulfil, others are but ingenious or expensive toys; but all go to prove that such a projectile has long been considered a desirable addition to the sportsman's battery, if not to the ammunition pouch of the soldier. For my own part, I do not hesitate to avow my conviction that sooner or later, they must be very extensively used in military operations, both from their immense utility, and from the profound moral effect which their employment even in small numbers cannot fail to produce. As I believe I was the first to use these projectiles in the field, systematically, and to any large extent, and as their high utility on several occasions has been acknowledged by many distinguished officers, who from what they then saw, have been led to advocate their habitual employment, a short account of their use and effects may be interesting here. You will forgive me for any seeming egotism, but the fact is, that as the shell were employed under my sole direction, it becomes necessary to speak in the first person, and I shall make my account as mere a statement of facts as possible.

In a lecture which I had the honour of delivering lately in this theatre, I described some of the events of the Umbeyla campaign, a series of operations against the mountain tribes of our Indian north-west frontier, which took place in the great hill range, lying about sixty miles north-east of Peshawur, and between that post and the Indus.

The story of these rifle-shells will tell you how I came to be concerned in those operations, and what their special uses under such circumstances are.

In the summer of 1863, my rifle-shell had been for some time under the consideration of the Government of India, and in the month of August of that year, a Select Committee was ordered to assemble at Meerut, to experiment and report on them. Their report was favourable as to their accuracy of flight, safety in use, and general effect on some artillery tumbrils, which indeed they had blown into a great many pieces; and after the conclusion of the experiments, I went on to Simla, where the coming hill campaign was beginning to be talked of. Whilst there I was asked to assist Major Gordon, Chief Inspector of Musketry, in carrying out some experiments, with a view to ascertaining the changes in sighting the Enfield rifle which should be made when firing at extreme angles of elevation and depression. European regiments, armed of course with that weapon, were to accompany the native troops into the hills, and it was justly thought that they might be placed in many situations where such a knowledge would be invaluable. These experiments were, however, barely commenced, when the force was in readiness to start, and no results of a sufficiently accurate nature had then been obtained.

Another serious difficulty moreover now occurred to us. The English soldiers had been trained, for some years past, in judging distances entirely in the plains of India, how then, even were they most accurately posted up in every variation of angle, could they estimate the distances of their enemies in the clear air of the mountains?

I had been then for two years a regimental instructor of musketry, and was necessarily in good training as a judge of distance; yet I found myself unable to estimate any distance whatever among the hills with any approach to accuracy. Any one who has shot much both in the plains and the mountains will at once, I think, admit how totally different are the rules to go by, according as he is placed in the one or the other. Even that forlorn hope of watching for the dust thrown up by the bullet would be unavailing in the hills, as there is no dust there. A bullet striking on a rock gives no indication whatever to the firer.

It occurred to me, however, that though a bullet does not, a shell most assuredly does, give such indication, and I was thus led to propose the use of my shell as a ready means of estimating distances on service, more especially amongst mountains.

Lord Strathnairn, then Sir Hugh Rose, and Commanding-in-Chief at the time, saw in this proposition a solution of the difficulty; and within three days I was on my way to join the force with apparatus for making up the shell on the spot, with a sufficient supply of chemicals, and letters which led to my obtaining the command of a body of sharpshooters, who should test the effects of those shell on the mountains or mountaineers, as the case might be. These men, thirty-two in number, were the best shots of Her Majesty's 71st and 101st regiments, and were speedily furnished with a certain proportion of shell ammunition per man, instructed to use it chiefly to ascertain their

distances, but permitted to fire a little freely with it at first, until they should become accustomed to its use.

The first occasion on which its effects were fairly tested was the following:—

During one of the first few days after the breaking out of open hostilities, word was passed down to camp that the outposts on the extreme right were in need of reinforcements; accordingly the mountain train guns, one hundred European soldiers, a native infantry regiment, and my party of marksmen were at once ordered up in support. On our arrival at the summit of the southern ridge, which bounded the Umbeyla Pass, in a situation some 3,000 feet above the main camp, we speedily discovered why we were wanted. Colonel Keyes who was in command of the advanced posts, had accidentally discovered that an attack in force on his own position was in the act of preparation. He, without waiting for it, boldly took the initiative, went at an enemy of whose numbers he could have had but an indefinite idea, and drove them before him to the end of the ridge. Here they crossed an open plain, and took up a strong position on a high peak, known to us as the Conical Hill, and he having but his own regiment with him, and now fully aware of their numbers, sat down on the last spur of the range, and sent for reinforcements.

When we came up, the mountain train guns were lifted from the mules, and the troops drawn up in a hollow, concealed from the enemy, whose dark masses and waving standards could, however, plainly be seen from a ridge a few paces to the front. The mountain train had evidently come far enough, and must open fire from this ridge, so also must the marksmen, for the present, at all events, and now came the question of distance. One said one thing, and one another, and at last I was consulted by the officer commanding the Artillery. Three or four rifle shell gave an average distance of 650 yards for the main body of the enemy, amongst whom the little shells bursting, seemed to cause some surprise.

The fuzes are now, therefore, cut for this distance, the marksmen all carefully posted, given the range, and ordered to fire with shell, but reserve their fire until the artillery opened.

The guns, masked by sections of grey-coated gunners, hardly distinguishable at any distance from the rocks themselves, are dragged up by hand to their places on the crest of the ridge, and aim is taken between the legs of their covering parties at a dense mass of the enemy, clustered round three or four tall standards, about the very apex of the cone. A few puffs of smoke here and there curl up from amongst the pines opposite, and the matchlock balls whistle overhead, or stick with a loud whack into the stems of the trees about.

Suddenly, at word of command, the grey sections wheel right and left, and show them the bright brass howitzers ready for work. Bang goes one of them, and everybody cranes his neck to watch the shell across the valley. All right, says somebody, as a flash and round cloud of smoke come out just at the proper place, and down goes the tall standard, and a dozen of its defenders with it.

More shell follow this example, and smaller puffs of smoke now

and again show that the marksmen, too, have found out the proper place, and are doing good work.

Presently the great mass of the enemy seems to waver, and here and there a man steals away, and vanishes amongst the trees.

Seeing this, Colonel Keyes gets his men together, sounds the double, and with his gallant regiment dashes across the plain, storms the hill, captures a standard, cuts up many of the enemy, and sends the remainder flying on the road home, the artillery shelling them pleasantly as they go. And so the action is over.

So immediate a success was, it is said, mainly due to the very rapid and accurate shell fire of the artillery, and in a measure also to that of the marksmen, which shook the enemy, and prepared their minds for the success of the final charge.

In producing this accuracy by ascertaining the exact range, I think the rifle-shell may claim to have done good service, and in some measure contributed to the results of the day.

Whether this be so or not, however, I think that you will agree with me that so cheap, expeditious, and certain a way of ascertaining range in difficult situations must have practical value. It may be said that the artillery could have done just as well by means of a trial shell or two. True, they could have done so, but then a first shell well pitched always carries with it a moral effect greater than that of any of those that follow, besides which English-made artillery shells cost something considerable on the tops of Indian mountains, some 60 miles or so from your base of operations, and still further from the nearest magazines, and must not be wasted if it be possible to avoid it,—as I think I have shewn it is.

After this, these shell were used frequently, both as a means of determining distances, and also on the enemy generally, when it became desirable to produce a strong moral effect. So well did they answer the latter purpose, that they were at the pains of sending us a deputation, under a flag of truce, praying that their use might be discontinued.

They considered them unfair on two grounds, I believe; firstly, because they exploded in an objectionable way; secondly, because there was nothing they could collect of them afterwards, as they could do ordinary bullets and the balls of the spherical case, and this they thought a great hardship. The spherical case indeed were a great prize to them, when, as sometimes happened, they failed to explode; for they used to shake out the powder, and then use the case as a pot in which to melt the bullets, until one day a sad accident made them cautious.

We had discovered this propensity; and several of the Indian Shrapnel fuzes having proved failures, we used common shell instead. This they were unaware of, and tried the melting process with one of the latter, a 24-pounder. We saw them dig it out, carry it carefully to their fire, and sit round till the lead should be ready. I need not tell you with what results. But I digress.

I attribute to the use of rifle-shell by the marksmen a degree of steadiness and confidence which enabled those thirty-two men to put

hors de combat, in four hours' hard fighting, no less than 180 men, at an expenditure of 12½ rounds per man hit—as high a result as has, I believe, ever been attained. One of the marksmen, Corporal Symester, of the 101st, picked off one of the enemy's chiefs at 750 yards; the distance of the spot where he stood having been before found by means of rifle-shell.

The services of these men were in constant requisition to indicate to their comrades, or to the artillery, the distance of any point on which fire was to be brought to bear, and were highly appreciated.

When General Chamberlain resolved on a change of position, and occupied the south side of the pass only, the opposite hill and our former posts on that side fell of course into the hands of the enemy; and we were continually annoyed by greater or less bodies of men, to whose fire from thence it became necessary to reply effectively.

I was enabled, by means of rifle-shell and a pocket compass, to make a rough and ready sketch of the position, for the use of the artillery and infantry, and accurately to lay down all the prominent points of the opposite mountain usually occupied by the enemy, with their distances from each work or *place d'armes* on our own side. When a regular plan was constructed by the engineers afterwards, I had an opportunity of comparing the two. There was a difference, but only in one distance, and that difference was only 20 yards in 950.

Such is a sketch—too long I fear—of what rifle-shell have already done. It now comes to be a point for consideration, whether such advantages as I have described, are sufficient to overcome the repugnance which, reasonably or unreasonably, undoubtedly exists to their use as weapons of war. I will endeavour to state the objections, usually made, as fairly as possible, and, giving them their full weight and importance, leave it to your judgment whether they should or should not be deemed prohibitory to us. That they will be so to other nations, or for a long period, I have much doubt.

The Prussians are said to be already arming some few regiments with the new shell-rifle of Herr Von Dreyse, which carries a shell charged with 2½ drams of powder, and is thus a far more formidable affair than any of those yet proposed for use in England. Another Power will, I believe, adopt them for use in the mitrailleuse, or many-barrelled breech-loading cannon. If this be so, and if the effects of rifle-shell prove in the field to be at all as great as I believe they will, their general adoption will follow as a matter of course, as has that of so many other inventions in war materiel, denounced in the first instance as diabolical, or ridiculed as useless.

In the meantime, however, an important advantage has not unfrequently been gained by the first to see the utility, override the objections, and boldly use them.

In the present case the objections usually made, are the very ones I have just mentioned, viz., that rifle-shell are either Satanic, or useless—if not both.

It is a cruel method of destroying your enemy, only to be classed with the bushman's arrow or the blow-gun and Wourali poison, says

one, and takes to himself credit, and honestly enough, I doubt not, for humanity, and a kind regard for the comfort of his fellow-creatures, even when arrayed in arms against him. Yet he will take a scientific pride in the acknowledged weapons and usages of war, and use them with a good conscience to the best effect.

An enemy approaches him by sea, let us suppose; he charges that enemy's vessel with his ram and involves 800 souls in a common and instant destruction. He fires a torpedo by electricity from a wooden shanty two miles off, under his feet, with a like effect; or, finally, he pours from his cupolas into his Martin shells the molten iron which shall burn its way alike deep into the wood of the ship and the tortured bodies of the seamen; in effect, in the terrible words of the old Letters of Marque, he burns, sinks, and destroys,—the human element inclusive. On land he disembowels him with rockets, buries in his path the self-acting fougass; tears his body with the angular fragments of segment-shell; plies him with grape and canister, old iron, and broken bottles; undermines him; fills up his wells, and destroys his habitations and supplies, and makes him to die of hunger, of thirst, and exposure, or linger, it may be, for weeks, from the fearful wounds of the bayonet, the sabre, or the Snider-Enfield bullet, the latter, by the bye, almost equalling in their effects on the body any produced by rifle-shell, as may be seen by the fragments into which such a bullet divides when fired into water. All this, moreover, with the best possible intentions and most serene good faith. But let me ask you, is this really humanity? Are any of the deaths to which the greater number of the killed in war are put, strictly speaking, humane? or, if they are not, what is this humanity of which so much is made? Is it indeed a branch of that quality which leads us to clothe the naked and feed the hungry, only developed in another direction? or is it not rather a term of variable quantity, applied to homicidal cruelty, and so adjusted as to be always just one step behind the last military discovery of the day?

Have we not heard that, in the dark ages, humanity beat out men's brains with a mace, whilst cruelty used the lance, the sword, or the arrow, and that the Bishops of the period, therefore, rode into action with the mace, so as to kill without shedding of blood? A very nice distinction indeed, as you will admit. In later times were not Congreve and Shrapnel denounced as monsters for the initiation of inventions, in whose perfection we rejoice to-day? and did not even General Elliot's red-hot shot find objectors, besides the unhappy crews of the Spanish block ships? Do not think, when I speak in this way, that I am proposing a new method of death, and doing a little by special pleading for its adoption. I am merely endeavouring to place before you the light in which similar inventions of accepted value have been regarded in times past, and mooting the question as to whether the present objectors to the use of rifle-shell have or have not more right on their side.

We next come to the question of utility. As a means of ascertaining range, you have already had their claims to notice laid before you. We now come to their use against the *matériel* and *personnel* of an

army. A rather favourite objection to their use against the limbers and ammunition boxes of the artillery, is that the powder and projectiles are so stowed in the boxes that the latter protect the former and render the whole invulnerable.

To this it may be answered, that this is undoubtedly, in great measure the case on a battery first coming into action. But we must remember that every round fired by it denudes in some measure the powder of this protection, and renders a serious, if not disabling, explosion, at all events, more possible; further, large cartridges are not nice things to handle, nor are powder cases pleasant to open when the flashes from rifle-shell are every moment bursting from the wood of the carriages and boxes, or starting from the iron of the wheels and guns; under these circumstances, even supposing the *personnel* of a battery to remain untouched, the service of the guns could hardly be carried on with the same *sang froid* as usual, even by the steadiest and best trained men. The more highly trained the men, of course the more fully aware would they be of the danger.

As to reserve small arm ammunition, the Boxer cartridge fortunately gives us a complete immunity from apprehension. But this is not the case with the small arm ammunition of other powers, with the exception perhaps of the French. If, therefore, our shell are to be used as now proposed, only on ammunition boxes, the artillery must be the principal sufferers. But in aiming at the carriage, one would be very apt to strike the man, supposing him to place himself in the way. That is, if rifle-shell are to be used against artillery *matériel*, we must include the men and horses belonging to the batteries—if not in theory, at all events in practice. In practice, therefore, it will be lawful and proper to shoot an artilleryman with a rifle-shell while in the execution of his duty, but nobody else. Humanity forbids us to destroy an infantry or cavalry soldier with anything but a solid or hollow-headed bullet.

We now come, I think, to a clear idea of what this inconsistent feeling really is. It is the desire to spare the infantry and cavalry soldier not one atom of suffering, not one pang in death (for the shell kills much more instantaneously and more mercifully than the bullet), but that unpleasant feeling which attaches to any SPECIES of death which men have not been accustomed to look in the face,—that dread of the unknown—which makes a child fear to enter a dark passage without a light—which keeps country people from a haunted lane—the bravest sailor from a harbour known to contain torpedoes—or makes gallant troops shaky on ground which is supposed to be mined.

That feeling which is—say what you will—at least akin to the sentiment which more than all the bloodshed in the world has lost its battles, and which it should be the object of every improvement in war materiel to produce, whether by its known or by its supposed effects—I mean fear.

Have not the Strasbourg experiments added a new terror to the French national weapon, whose *prestige* has been augmented ten-fold by the horrid nature of the wounds it produces, wounds which, since then, the French army surgeons at Mentana have declared to be

beyond everything they had ever seen—and from their nature almost always fatal; and is there not too an undefined, and perhaps exaggerated, feeling of mingled curiosity and dread in many minds abroad as to the effect which will be produced when that mysterious *mitrailleuse* of the Emperor, whose secret is so carefully kept, once sees the light of a day of battle?

Such dread would ten-fold attend the steps of a power which should be known to possess an infantry rifle-shell, and boldly declare its intention of using it, if compelled to fight for its existence.

I firmly believe, that a greater effect would immediately accompany its first use than has done the substitution of the muzzle-loading rifle for the smooth-bore, or even that of the breech-loader for the former.

No one will face a rapid and well sustained infantry fire of shell, as all who have seen them much used, are agreed, at all events until accustomed to them; and this takes time. But if they will not face them, then life is saved rather than destroyed. In fact the old argument holds good for each fresh step in advance; the more terrible the recognised engines of destruction, the greater will be the prospect of maintaining peace; or, should war break out, the shorter of necessity will be its duration.

As this is an object for which we all, soldiers as well as civilians, should strive, I trust that the rifle-shell may receive, at all events, thoughtful consideration, as a candidate for the office of peace-maker to begin with, and as having a tendency to shorten any war once commenced, where its use is properly persevered in.

Lieut.-Colonel FLETCHER, Scots Fusilier Guards: There is one question which I should like to ask, viz., that when you used the rifle-shells, did you use them from the Enfield, and had the rifles to be specially sighted for the purpose?

Major FOSBERY: They were used from the Enfield, and the weights were so adjusted that they travelled with the same sighting as the bullet; it was by that means we were able to ascertain our distance.

Colonel FLETCHER: Could they be used with a smaller bore than the Enfield?

Major FOSBERY: Perfectly. Here is a specimen of a smaller bore than the Enfield, viz., ·451, many of which have been fired successfully.

The CHAIRMAN: If no gentleman has any further observations to make, it remains for me to propose a vote of thanks to Major Fosbery for the paper he has brought before us. I am sorry that there are not some of the members of the Council present, who have given great attention to this subject, for it is not one with which I am practically acquainted. There is one gallant officer here who could address us on the subject; but I suppose he feels himself tied by his position as Chairman of a Committee on breech-loaders. There is one omission in Major Fosbery's statement, which perhaps I may supply. In that very action which he described so graphically, in which these shells did such good execution, and were, likewise, so valuable in enabling the men to determine their distance from the enemy, Major Fosbery earned the distinction of the Victoria Cross. That I think is the only observation that I have to make. I will now in the name of the meeting return our best thanks to Major Fosbery, for the very interesting paper he has read, and also for the very clear manner in which he has placed these various inventions, as well as his own, before the meeting.

Evening Meeting.

Monday, February 3rd, 1868.

REAR-ADMIRAL SIR FREDERICK W. C. NICOLSON, Bart., C.B., Vice-President, in the Chair.

NAMES of MEMBERS who joined the Institution between the 20th January and 3rd February, 1868.

LIFE.

Mosse, Wm., Major 26th Regt. 9*l*.
Stopford, A. B., Lieut. R.A. 9*l*.

ANNUAL.

Luard, W. G., C.B., Capt. R.N. 1*l*.
Crokat, Chas. F., Esq., Clerk, War Office. 1*l*.
Corballis, Jas. A., Lieut. 98th Regt. 1*l*.
Elphinstone, John, Lt.-Col. Staff Corps. 1*l*.
Wilson, John, Capt. 42nd Roy. Highs. 1*l*.
Morrieson, R., Col., retired f.-p. Indian Army. 1*l*.

FURTHER INFORMATION ON THE EMPLOYMENT OF MINERAL OILS AS FUEL FOR STEAM SHIPS.

By Captain J. H. SELWYN, R.N.

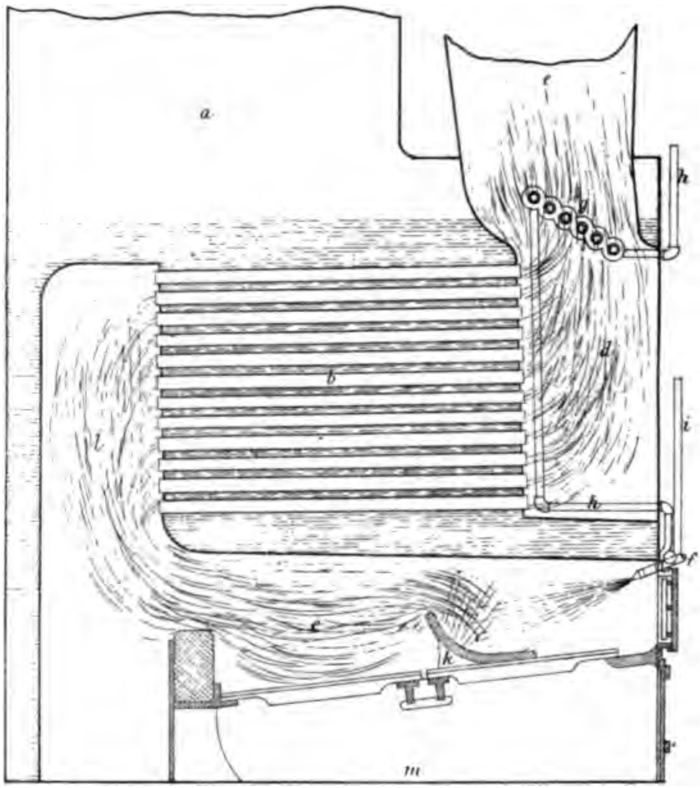
IN my first paper on this subject, read before the Institution at the request of the Council on the 16th of January, 1865, I attempted to give a slight sketch of the origin and history of mineral oil, its chief characteristics, and probable uses. Since that time I have been assiduously working at the question, and a great variety of methods, all more or less successful, have been put in operation with the object of burning certain classes of these oils as steam generators. Some of these methods have failed of complete success from one cause, some from another, but I am justified in saying that they have been all in a measure successful, for one great truth has been incontestably established. The duty done by even the coarsest descriptions of mineral oil, as an evaporative agent, ranges from $2\frac{3}{4}$ to $3\frac{1}{4}$ times that of coal, and this result can be obtained without any special boiler being used. In saying this, I am taking 7lbs. of water only as the practical result of burning average coal, for though 10lbs. have been evaporated under exceptional circumstances, this is never obtained in actual work, and 7·5lbs. is the practical evaporation in some of the most economically conducted lines of steamers of the newest construction.

I have heard that some of the members of this Institution fail to see of what interest it is to follow this enquiry. A few words on the importance of the subject may, therefore, not be out of place.

Our annual total of coal raised for all purposes in Great Britain has now reached the enormous amount of 106,000,000 tons. It increases yearly by about 3,000,000 tons, and although we need not have much fear of the supply soon failing, it is necessary to use a wise economy

An ordinary Marine Steam-Boiler with return Flue Tubes.

Fitted with "Wise, Field and Aydon's" patent system for burning liquid hydro carbons



a The Steam Space.
b. The Tubes.
c The Furnace.
d. The Smoke Box
e The Uptake.
f The Injector
g The Superheater.
h Pipe conveying Steam to Superheater, and Superheated Steam to the Injector.
i Pipe for supplying Oil to Injector.
k. The Baffle.
l. The Combustion Chamber.
m The Ashpit.

J. Jobl

whenever it can be practised, for fuel is one of the great, if not the very greatest, mainsprings of our wealth. He who can do with one ton of fuel that which could previously only be done (if done at all) with two, has doubled production and halved cost in such an infinite variety of ways, in such endless ramifications of industrial pursuits, that there is no one so high that he might not derive personal benefit from it, none so low that it would not materially influence the increase of necessaries or comforts he might command.

If we turn to the history of our great steam lines, we find that constant complaints have been made, that without large Government subventions nominally given for carrying the mails, they could not continue to exist, and that the expense which chiefly absorbs profits, is that incurred for fuel. If again we inspect the accounts of our Navy, we find that the expenditure of fuel in our steam ships-of-war, no matter how carefully economised, is one of the great items which makes it unfair to expect that navies should cost no more in the present than they did in the past.

There are many articles of commerce which cannot profitably be brought to market by steamers, and yet which are too perishable to bear the lengthened voyage of a sailing vessel. Extend the time during which a steamer can be driven at full speed, and your colonies are no longer so distant, the nations of the earth are brought nearer to each other. But when, in addition to the increased power of carrying fuel, the fuel itself is so changed in quality as to be more easily managed, whether in stowage or combustion, when by its use we are insured against the choking of pumps by coal dust, the loss of heat by deposits of carbon, when three stokers can do with ease what thirty were not more than competent to perform before, when, in short, so many minor advantages are to be gained, that it would tire you were I to attempt the enumeration of them, I do think that no time that is given to such a subject in such an Institution as this, can be otherwise than *time well spent.*

I regret that the boiler which has been ordered by the Admiralty for a steam launch at Woolwich is not yet quite ready for trial, in consequence solely of the time taken in adjusting the rather complicated twin screw engine which has to be fitted to it. The system which I believe to be the best and most simple, yet brought forward, and on which this first marine trial is being made, is that known as Wise, Field and Aydon's, and is represented in Plate II, and by the principal part of the apparatus itself on the table. Extended trials have, however, for some eight months past been made with it under ordinary Cornish and steam fire-engine boilers, and there is no reason to believe that the results to be obtained from marine boilers will be in any degree less satisfactory, although this particular steel-launch boiler is governed in its shape by the boat and engine to which it belongs, and is also equally well calculated for coal, if preferred.

It will, perhaps, tend to clear the ground if I commence by passing in review the objections that have successively been made to the employment of mineral oil as fuel, noting against each how far they have as yet been answered by our experience.

First then, and most important, had they been true, were the chemical theories by which it was attempted to be proved, that no greater, or only very slightly greater, evaporative value could be obtained from mineral oil, than from good coal. But here, when I sought the assistance of Professor M'Quorn Rankine, we were told in the admirable paper read before the Institution (and published in the Journal, No. 44 of last year), that this was the error of those chemists who had not studied the subject—for by the highest authorities it had been conclusively shown that nearly 23 lbs. of water ought theoretically to be evaporated by the combustion (if perfect), as it might easily be, of 1 lb. of hydrocarbon, having a constitution ranging between carbon 18, hydrogen 20—and carbon 26, hydrogen 28—or in per cent. (carbon 84, hydrogen 16), and (carbon 85, hydrogen 15). This was from laboratory experiments. I have here a pamphlet published in America, describing the results which appear to have been very carefully arrived at, of an apparatus invented by Colonel Foote, in the United States, for burning these oils in what seems to have been a 10 horse-power boiler or thereabouts. It contains testimonials from 100 engineers of all nationalities who saw the boiler in operation. The experiment has been very carefully gone through, and is scientifically tabulated throughout. It is, however, difficult to understand how the evaporation which seems to have been obtained of 23·745 lbs. of water, by one pound of petroleum was secured with carbon 12, hydrogen 12, which is said to have been the chemical constitution of the oil used.*

The experiments made hitherto in this country have given, when good apparatus was used, and all deductions made, from 19·5 lbs. to 21 lbs. of water evaporated per pound of hydrocarbon burnt; I say hydrocarbon, because we are content to use a coarser form of oil at a lower price than has been tried in America. This comes under the denomination of creosote, or dead oil of tar, and I am informed that 3,000,000 gallons of it were lately bought at three farthings per gallon, or about 13*s*. 8*d*. per ton. Here seems a good answer to the bugbear of high price, seeing that this oil is considerably cheaper than coal; I will advert however to this point again, and give you now a few evidences of what I have already asserted as to evaporative power from actual practice.

During some nine hours' trial of a ten horse-power Cornish boiler driving the machinery of a large factory; the duty done by creosote burnt in Messrs. Wise, Field and Aydon's apparatus was 19·5 lbs. per lb. of fuel. This experiment has been several times repeated.

Mr. Alfred Crow, with his apparatus, gives 1 ton of oil = 3 tons of coal.

* Carbon 12, hydrogen 12, in something like the same proportion as olefiant gas, which is carbon 4, hydrogen 4, and gives (see Professor Rankine's paper) 22·1 units of evaporation, while Captain Foote claims (see above) 23·7. But this may be due to the carbon being in a measure pure gaseous carbon when burning, when it would give a higher evaporative value than 11·25 (see Professor Rankine, page 223, No. 5 in the list of elements, and page 224, near the bottom, commencing "If we could get pure carbon in the gaseous state."—J. H. S.

Mr. Barff claims 22 lbs.

Mr. Thomas Crow of West Ham has used mineral oil in his apparatus for eight months to do the regular work of his factory. Each lb. of oil has evaporated 18·91 lbs. of water.

Another firm using this apparatus, state that the oil weighs 10·5 lbs. to the gallon. 85 gallons did the work of 1 ton 2 cwt. 3 qrs. coal, 2,548 lbs. against 892, or 2·86 more than 2¾ times the duty of that coal.

Mr. Goddard of Ipswich says, "My experience shows me that 1 ton of creosote will do the work of 3 tons of coal as fuel.

Mr. Richardson 18·5 lbs.

Mr. Crow's experiment in Mr. Richardson's boiler at Woolwich with creosote, 18·91 lbs.

In order to fix a limit, beyond which any claim of evaporative power may fairly be treated as delusive, we have only first to consider, as has been so ably shown by Professor Rankine, following the extended researches of Messrs. Fabre and Silbermann, that the more hydrogen, the more heating power or evaporative duty is theoretically contained in any substance, unless there be also oxygen present, and that the evaporative power by experiment of marsh gas carbon 2, hydrogen 4, or by weight ¾ of carbon to ¼ of hydrogen, is no more than 24·3 lbs. of water to 1 lb. of the gas. In fact with the paper of Professor Rankine, and a correct chemical analysis of the substance proposed to be burnt as fuel, there should not be the slightest difficulty to any one of ordinary capacity in estimating the evaporative results which ought to be obtained with a well-constructed boiler and apparatus.

I venture to think that I may now leave this part of the question, in the confidence that you will accept the conclusion that I have come to, viz., that both chemically and mechanically, theoretically and practically, it has been proved that, hydrocarbons have the power of evaporation here claimed for them, viz., at least 2½ times that of coal. Above all do not let us be frightened or dissuaded from proceeding by any interested and mistaken outcry from the producers of coal, which so soon as even partial success be achieved, will not fail to be heard. They have to make the most of their coal; but we have to make the most of our navy; and I am persuaded that in this, as in all other cases, any such economic change will be eventually for the good of all classes, however much it may be combated by vested interest at the outset.

The second and next strongest objection taken to the employment of mineral oil as fuel, was the cost. This was by the objectors unwisely assumed to be the price of such oil as can be burnt in lamps. I can only repeat that of such oil as is really required, and which is now entirely a waste product, 3,000,000 gallons have been bought at three farthings per gallon, or about 13*s*. 8*d*. per ton, and that any number of millions more would be forthcoming in every part of the world, very little, if at all, enhanced in price.

If we take the Havre line of American steamers as a specimen of the results economically of burning coal, as Mr. Stimer has done in Colonel Foote's pamphlet, substituting for the 3½*d*. he makes his refuse oil cost

in America, the three farthings for which, what we want, can be got here, we arrive at very interesting results as to what might be the price of our oil before we should have to give it up as an economic success; I say economic, for the advantages in a remoter sense of enabling steam to go where it never went before, without stopping for fuel, are so boundless that I could not attempt to enumerate them within the limits of my paper.

In the Havre line there was burnt in each vessel 55 tons of coal per day, the average length of passage being 11½ days. They would then, therefore, burn on the two voyages out and home, of coal 1,265 tons, or of oil nearly 422. Each ship carries besides engineers, storekeepers and *oilers*, twelve stokers at £10 per month, and twelve coal-trimmers at £8 per month.

The food of these men costs 40 cents (1*s*. 7*d*. nearly) per day each, and they each occupy 15 cubic feet of space, which would be devoted to cargo in their absence.

Three of the firemen would be retained if oil were used.

These ships leave port with 750 tons of coal, and would have to put on board 296 tons of oil, leaving 454 tons of space for additional freight on account of coal space saved and 8 tons on account of less number of men, making 462 tons additional freight space.

The average rates in America for inward freight amount to say 24, 50 dollars currency, or £3 8*s*. sterling, and outward to Europe about 12 dollars currency, or £2 sterling. (*These figures do not represent present prices of gold or freight exactly.*)*

We then have:—

Cost of Fuel as burned.	£	*s.*	*d.*
1,265 tons of coal for both voyages at 17*s*. ..	1,025	0	0
Wages of nine extra firemen at £10 per month, two months	180	0	0
Wages of twelve coal-trimmers at £8 per month, two months	192	0	0
Food, 21 men, 60 days, at 1*s*. 7*d*. per man per diem	100	0	0
Total cost of coal	1,497	0	0
Total cost petroleum, 592 tons at 14*s*... ..	414	8	0
Balance in favour of petroleum..	£1,083	12	0

Now for the saving in bulk:—

	£	*s.*	*d.*
From the United States, 462 tons freight at £2 and 10 per cent. primage..	1,017	0	0
To the States, 462 tons freight at £3 8*s*. ..	1,520	0	0
	2,537	0	0
Add balance for petroleum as above ..	1,083	12	0
	£3,620	12	0

* These calculations are adapted from Mr. Stirner's clever pamphlet.—J. H. S.

Now let us see how much 592 tons of petroleum may cost and still compete with coal without taking saving in bulk into account. It may cost as much as 1,265 tons of coal at 17*s*., *i.e.*, £1,025—or about thirty-four shillings per ton, and there will still be a saving of about £470 per round trip. But if we admit the other bulk savings shown, then it may cost about £6 per ton, and yet there will be a commercial advantage.

I shall now also leave this part of the subject, for I think it scarcely requires demonstration, that to ensure the efficiency of our ships of war for two-and-a-half times as long as we can now do without going into port, at once presents advantages which throw into the shade all the minor economies, great as they undoubtedly would be.

Another seemingly valid objection to the use of mineral oils, was the danger which might be incurred from fire, if through any want of caution, the hydrocarbons were allowed to escape into the ship, either in their original form, or as gaseous products which mixed with a certain quantity of atmospheric air (from nine to thirteen parts), would become explosive. I will at once answer this objection by remarking that coal tar has been carried and used on board ships for the last quarter of a century. It is infinitely more capable of giving off gas than such creosote as we wish to use, and even than many of the other hydrocarbon oils—and yet I have never heard in the Navy any complaint about it, save that some zealous First Lieutenants could never get enough of it for the ship's consumption. Secondly, as this creosote happens to be heavier than water, a film of water may always be kept over it in the tanks or other receptacles, which in the improbable event of a red-hot shot piercing the armour-plated side, or in any other way getting into the tank, would prevent the access of air to the surface of the oil, and would insure its being easily covered with water to extinguish it, if after escaping on the decks through a shot-hole, it took fire.

I consider this, however, to be nearly impossible, for I have heated white pine up to 200 degrees before the fire, I have then poured the creosote upon it, and nothing but a piece of flaming charcoal would ignite it, a red hot coal having no effect, nor flame either; when by the combined heat of the glowing charcoal and flame it became ignited, it burnt freely, but without even singing the soft-wood under it. It is not subject to spontaneous combustion as some coal is. It is more easily put out when ignited, and if run into the hold where there were a few inches of water, it would be extinguished by the salt water taking the place due to a sp. gr. of 1,020 or 30—the oil being 1,050 sp. gr., unless indeed the water were from the Dead Sea, when, as that has a sp. gr. of 1,240 and the oil about 1,050, we might possibly have the oil on the top. I have also brought this substance to a boiling state, and then approached flame to it, not even then did it take fire, unless there happened to be some substance which acted as a wick, and by capillary attraction minutely dividing the particles, enabled the oxygen to combine in sufficient quantity with the carbon and hydrogen of which it is composed. I then heated it in a thin film on a sheet of

metal till it was in a state of ebullition, and then on applying some lighted paper, and dipping it into the oil, a flickering transitory flame appeared, which went out when the paper was removed. Under no possible conditions can I therefore regard it as explosive or exceptionally dangerous as fuel. Ignitable it must be, or it would not be fuel. Specific gravity is always a good guide to avoid danger in petroleum.

I have now touched upon the points of evaporative power, economy, and safety, and these I think were the chief obstacles to the general acknowledgment of the great benefits to be derived from such a new steam generator. But if I have established that we may use it,—and our coal bills say we ought to use it,—the next thing to demonstrate is, how it is to be used. And here, as I cannot quote Professor Rankine's whole paper, I must refer those who wish to study the question to that as their text book. He has shown that it is of the first necessity that a good form of boiler be employed, that is, that the "efficiency of furnace," as he calls it, should be high, no matter what fuel is used. But no man can make an equally good furnace at one time for every kind of fuel. Therefore to make a highly efficient furnace, he must know the composition of, and the method of decomposition or burning of the fuel, he is called upon to provide for. As long as there is a smoky chimney in Great Britain (and neither they nor the other evil alluded to in a well-known proverb, have yet come to an end,) we have direct evidence for both nose and eyes, that perfect combustion of carbon in the solid form, has not hitherto been ranked among the triumphs of science. But when we find that such carbon ought to give us 15 units of evaporation, and does practically give us 7·5 just half, who will not acknowledge, that substantial progress in applying a new fuel has been made, when the total evaporative power being 27·3 (I refer to marsh gas and similar hydrocarbons), laboratory experiments give 24·3, and actual practice on a considerable scale 23·7.

If you will recollect that these are the results of experiments made in boilers not specially adapted for the oil, you will see that we need not fear to be compelled to any large expenditure on account of change in that direction. The adoption of circulating water-tubes, instead of the present smoke-tubes, would no doubt be most advisable, and would speedily pay for the expenditure, if only in diminished salting up or incrustation, an evil naturally more severely felt in marine boilers than in any others; but there is no absolute necessity for any change whatever, and with such apparatus as that on the table, the same boiler may either burn coal or oil, as preferred; and more, any boiler now in any steamship could be fitted in a month, at a very small expense, with all that would be necessary in order to enable her to burn creosote or dead earth-oil—as far at least as the furnaces were concerned. The division of the existing coal-bunkers into receptacles for the oil would not either be a very long or difficult task, and the increased profits of the first voyage would probably pay, and over-pay the whole amount expended.

But if any apparatus is to answer for a long time in the intense heat which is indicated by the high evaporative power of hydrocarbons, it

must be of the very simplest character,—even more simple (or else less exposed) than the fire-bars of an old furnace,—for they oxidized and bent, were burnt out, and were so made as to be easily and cheaply replaced; and in my selection of a system for recommendation to the Admiralty for trial, I have been mainly guided by these considerations. The apparatus of Colonel Foote exhibits more evaporative power; but not only does he use an oil which I could not expect to be accepted in this country, but he confesses himself beaten in point of simplicity and durability by Mr. Aydon. As I have no wish to engage in an inventor's quarrel, I shall refrain from any but general descriptions of the systems now in use. I understand there are no less than three gentlemen of the name of Crow, who have different systems in operation, and I have no doubt each and all who have invented and patented a "Mineral Oil-burning Furnace," think their own particular one, the "Black Swan." The main duty to be performed is, first, the thorough decomposition or mixing with oxygen in sufficient quantity, and no more than sufficient quantity. This is done in Colonel Foote's and other apparatus, by a heated retort or receptacle of whatever kind, exposed to heat in the furnace. Here the oil is, in all such apparatus, vapourised, and the difference between the varieties is, that in some, air or atmospheric oxygen, in some, both air and superheated steam, are introduced into these retorts, and there mixed with the hydrocarbon gases; in others the mixture is allowed to take place outside at the moment of combustion. I say outside the retort, for after the formation of the mixture, or, in the latter case, at the moment of formation, the gaseous compound is ignited as at gas-burners, and thus sends forth its heat into the furnace. But the system which I prefer, is one which dispenses with the retort altogether, and has nothing but fire-brick, and a superheater in any part exposed to the heat; a nozzle, or jet of superheated steam, placed over the dead plate induces round it a strong current of atmospheric air. United they impinge upon a small stream of the creosote oil, divide it mechanically into fine spray, and at the same time transform it chemically into the proper mixture of gaseous compounds with oxygen. A greater or less quantity of fire-brick is placed to receive the impinging flame, which has not a trace of smoke, and when in perfect action shows only a blue or purplish colour, this heat absorbing material fire-brick, being productive of two valuable effects, the one that of sustaining an equable heat during active combustion, the other of retaining sufficient heat to prevent the too rapid cooling of the boiler which might ensue from suddenly extinguishing the jet. A very beautiful and, I think, chemically-perfect combustion, is thus obtained.

I ought here to confess, that in 1865, though I did not myself assert, as of my own knowledge, that four to five times the evaporative duty of coal would be done by mineral oil, yet I was led to express that hope by the too confident statements of others. Further acquaintance with the subject, and months of study, have led me to a less enthusiastic but better founded conviction. Yet I can scarcely be thought wrong in having pressed so important a subject on your attention, even though it were with a little too much zeal. Though that may be a

disqualification in the diplomatic service, it has never been held to be one in my own.

Having now asked for so much of your time and attention, in saying what I thought might fairly be said in favour of this new fuel, I should think myself unfair if I did not also tell you all I know which may operate against it. There is, so far as I am aware, nothing of the kind which should prevent its being generally used. But there are special points to be guarded against beyond those obvious ones, which the objectors seem yet to have urged. When mineral oil is in active combustion, the process goes on unremittingly, and without fail, but the question of lighting it involves more difficulty. In some of the systems, superheated steam, in all a forced current of air, is necessary to prevent imperfect combustion—and a consequent deposit of unburnt carbon or soot on the heating surfaces. This is by all means to be avoided. Where superheated steam is used, this could be given from a donkey-engine, and air may be obtained from the same driving an air-pump, where it is air alone that is required. But it would be false economy to allow the tubes or other heating surfaces to be coated with a non-conducting surface at first. In a very small engine and boiler, the process should be started with coke or charcoal, or in some boilers, wood may answer. There are next two chemical peculiarities of these fuels, which depend on temperature, and to which I wish to draw your attention. I cannot give the exact temperatures, as this will depend on the constitution of the particular hydrocarbon we are using, but as to creosote, the phenomena are these:—If raised to a temperature of over 230° F., naphthaline begins to form, if any be present, and this will give trouble with the supply-pipes by choking the flow. If, on the other hand, the temperature be lowered to 32° F., a portion of the oil solidifies and does not liquefy again till a temperature of from 60° to 70° of Fahrenheit has been re-attained. Now, the objection about rise of temperature, as in the first instance, is not so important, for it is one that only requires attention to avoid; but the second is far more serious. It is true that a large portion of the oil remains liquid, even at 7° below zero, but this will not prevent the necessity for having some means of heating slightly the contents of each tank or receptacle for oil as it comes into use. Steam is the most convenient agent for this purpose, and a coil or two of pipe, being part of the fittings of each receptacle, must be turned on from a main as required. I do not think this is a thing to be frightened at, for the quantity of oil to be carried, in some cases, will be so small as to be stowed in the immediate vicinity of the boilers; in others where every nerve must be strained to carry as much fuel as possible, it will be but a slight tax on the many advantages gained in other ways, to have to provide for the oil being heated when in a frigid climate. But here again we have a chemical resource also open to us, and that is so to mix our oils as that the degree of cold that may fairly be expected, will not freeze them. I do not know what we could do for the next Arctic expedition if one ever takes place. I fear we must leave them to solid coal or pure alcohol as their best fuel.

I have ascertained to-day that 60,000,000 gallons of creosote are

produced yearly in Great Britain as the refuse result of tar-distillation alone. A still greater quantity can readily be obtained wherever the illuminating mineral oils are made.

The apparatus which I will now explain, has evaporated about 60 tons of water in actual work under a Cornish boiler. It is, as you see, about the length and size of a man's fore-arm, and has three concentric tubes, something on the same principle as Giffard's injector, one of which blows superheated steam, inducing in the others respectively atmospheric air and the oil to be burnt.

I have now only to thank you for your kind attention, and to apologize on the score of an accident by which I have been for two months confined to the house, and from which I am only just sufficiently recovered to appear here, for the incomplete way in which I have put the subject before you. It is one that will, I am persuaded, gradually increase in interest, and when further information has been attained I shall endeavour, with the permission of the Council, to make up for any shortcomings now unavoidable, and to give you a report of our trials in the steam launch now fitting for the Admiralty at Woolwich.

Admiral Sir HENRY CODRINGTON, K.C.B.: There is one question that I should like to ask. Is it necessary that it should be high pressure steam? High pressure steam is a cold operation, I have always understood. Ordinary steam gives you the full heat. But the sensation of high pressure steam—for I have put my hand into it—is a cool sensation. There is another point I should like to ask a question about. It seems to me that the quantity of fire-brick underneath the boiler bears such a small proportion to the area of the lower part of the boiler, that I can scarcely imagine that amount of fire-brick keeping it hot? With respect to the word creosote, I understand it to be the heavy refuse that is used, not the light article that we buy of chemists. Not the distilled creosote, but the coarse refuse.

Captain SELWYN: It is the coarse creosote.

Mr. C. J. RICHARDSON: You mentioned that Mr. Crow, the creosote-maker, produced an evaporation of 18·98 lb. of water to 1 lb. of creosote. He has published a statement to that effect, and has taken out a patent. Now I beg to say that that result was obtained with my apparatus, not with his. I lent him my boiler at Woolwich one entire day, for burning creosote, and it was with my apparatus that he made the experiment.

The CHAIRMAN: I believe that some gentlemen connected with this patent, of which there is a sketch on the wall, are present. We shall be happy to hear any observations they have to make.

Commander COLOMB, R.N.: I am afraid that the subject is too new to provoke much discussion at present; but I have no doubt that after we have had time to read the paper in the "Journal," we shall be able to say something to the point. As far as I understand the question, it is certainly well worth the very closest attention. If you say that we are to gain 2½ tons in stowage in our ships, or, in other words, to go 2½ times as great a distance for a given space of stowage in our ships, I think that most important. With regard to the lighting the furnace, I do not quite see how it is managed. If I understand rightly, you must lay a fire in the first instance, or something in the nature of a fire, because you have to get your commingled spray of superheated steam and oil to start combustion.

Captain SELWYN: Not to start combustion. There is combustion at first, but with the production of some carbon, unless there be superheated steam present. As soon as the steam is raised, it becomes superheated; and then no unburnt carbon is given off. It is to obviate the objection of coating your tubes with carbon or soot.

Commander COLOMB: Then I understand that, to begin, you must employ a fan or bellows of some kind, to produce a current of air; or else you employ a second boiler,

with a small coal fire under it, to produce your superheated steam. I do not quite understand the point of starting your boiler; perhaps you will make that clear.

Mr. RICHARDSON: It is generally supposed that all these oils, shale oil, petroleum, and dead oil, vaporize; that they have only to be mixed with superheated steam to be burned as vapour. Those who say that, know nothing of the nature of these oils. They do not all vaporize. There is only a small portion, about 30 per cent., of oil, that does vaporize; and in different proportions in different oils. The American petroleum vaporizes the most; that vaporizes 40 or 50 per cent. It is absurd to suppose that you can take shale oil, or dead earth oil, and pass it through a pipe and make it vaporize. You cannot make it all vaporize. If you put it into a coke fire, all the tar will come out as tar, and put the fire out; it will go into the ash-pit, and burn like liquid fire. And if the supply of oil is not quickly shut off, that liquid fire will run out of the furnace like a stream. It is a mistake to suppose that superheated steam will make it burn. No superheated steam will make it burn; it requires to be bodily burnt.

Mr. MACKIE: There is one point which I think is worth while to bring before the meeting this evening. I know that rock oil has been burned in many ways, and that a very considerable amount of evaporation has been accomplished per pound of oil burned. I am not aware what experiments have been made or carried out, to ascertain the rate in regard to the time in which this evaporation is effected. I certainly am not adverse to the employment of mineral oil, therefore I do not speak in an antagonistic spirit at all in the matter. Everybody who has anything to do with, or has any experience of steam ships, must be very well aware that in getting up steam in great boilers, and in great abundance, for special purposes, or even for ordinary purposes, the high rate is attained by the system of firing; that is, burning coal at any amount of extravagance, so long as you raise the quantity of steam required. As far as I know, the experiments made with rock oil have been to evaporate simply so much water per pound of oil, regardless of the time it takes to do so. I should like to know whether, under Mr. Aydon's system, or any other system which has been tried so far, something equivalent to the system of rapid firing has been tried?

Mr. LEWIS OLRICK: I believe it is admitted that combustion has been very unsuccessful in nearly all steamers up to the present time. When we see a steamship, we are in the habit of seeing a long trail of smoke in the wake of that steamship. What does that mean? It means simply waste of fuel; inattention to the very first rules of how to consume coal properly. The reasons are, first, faulty construction of boiler; and next, the want of applying atmospheric air, which we can get for nothing, to combine with the gases we get from the coal, and thus to burn them properly. In many instances it is almost impossible to get a smoke consumer to act, simply for want of draught. Therefore, certain smoke consumers in which a steam jet is applied, are in most cases preferable, because we have then a mastery over the amount of air which we can inject into the furnace. Comparing coal with liquid fuel, we have got certain advantages in the liquid fuel which we have not got in the coal. In the first place, with regard to coal, there is the faulty construction of the furnace and want of attention to the proper amount of air that comes in. Next, and not least, is the chance of a bad stoker. A bad stoker can almost spoil the very best constructed boiler; at least the combustion that takes place in the best constructed boiler. Now, nothing of the kind occurs with a liquid fuel furnace. After the furnace is once started, it will go all round the earth, if it is only supplied with sufficient oil, with very little attention: and instead of having a whole army of stokers, you may have two or three, with perhaps one in reserve in case of illness; that would make four stokers, instead of twenty-four in one ship. Although I made the boiler which is now being fitted up in Woolwich Dockyard, I believe my friend behind me (Mr. Field) knows a great deal more about the combustion of liquid fuel than I do. But I have seen many cases, and I must say that at first I did not believe it was possible to produce so entire a gas flame, as I saw in the flue of an ordinary Cornish boiler of about 10-horse power. When we want to learn how to burn oil properly, we have merely to look at a parafine or petroleum lamp, and there we have a full explanation of how to do it. If the same

principle is applied in reality, as shown on that drawing on the wall, we shall get about the same amount of perfect combustion in the boiler flue as we get in our lamp. Again it will be preferable to get steam to inject not only the oil, but also the air; because we then become master of the amount of air that must necessarily go into the furnace to effect a perfect combustion. If we add to that steam a certain amount of heat, and superheat it, we know very well that highly superheated steam will decompose, and separate the hydrogen from the oxygen. Hydrogen, as far as I recollect, has 64 units of evaporation; that means that one unit of hydrogen would evaporate 64 units of water if it were possible to do so in a furnace. There is one point more. If you light up the fire with coal, as I have seen this morning in Woolwich Dockyard, you coat the whole of the heating surface with a thick layer of soot, one of the worst conductors of heat we can have; and the efficiency of the boiler sinks down from 20 to 18 and 16. The first thing you must do is to start with a clean heating surface; then you will have the full efficiency of both the oil and the heating surface. This is impossible to acquire in the ordinary coal furnace, because when you light up, you must necessarily have smoke to commence with, because at the first moment it is impossible to inject the necessary amount of air, to effect perfect combustion. This is one of the evils connected with the ordinary furnace, which will be entirely avoided with any perfect liquid fuel.

The CHAIRMAN: You alluded to some experiments at Woolwich. Were you referring to the boiler that is going to be put into the steel launch?

Mr. OLRICK: No. The boiler I am fitting into the steel launch is ready; but I am also fitting two pair of engines to the boiler itself; and on account of some small difficulties that have arisen, I have been delayed in fitting them in the manner that was first intended. The one I alluded to this evening, is in another small steamer lying there with an apparatus of Mr. Barth's. As far as I can see, Mr. Barth has simply imitated the system that you see on the table, with some slight additions that entirely destroy the proper action.

The CHAIRMAN: You say it is Mr. Barth's apparatus?

Mr. OLRICK: I was told by the officials that it was Mr. Barth's.

The CHAIRMAN: Is it a boiler for burning mineral oil?

Mr. OLRICK: Yes, but I do not know whether I saw it the whole time it was in action: but I saw it for nearly an hour smoke to that extent that it was almost dangerous to go near it.

Captain BURGESS: I should like to ask one question, viz., that were this oil used as fuel in the Royal Navy, would the present boilers require much alteration?

Captain FREMANTLE, R.N.: I wish to ask a question as to the cost of the oil. The cost is stated at 14*s*. a ton. I want to know, if the fuel was used in very great quantities, whether it would make any material difference in the price; and whether the amount that would be required would be so great that there would be any difficulty in obtaining the supply in this country, or would it be necessary to get it from America?

The CHAIRMAN: If no other gentleman has any observations to make, I will call upon Captain Selwyn to reply.

Captain SELWYN: First with regard to Admiral Codrington's questions, he must permit me to read from a much more able author than myself a better answer than I could possibly give. I asked Professor Rankine, when he read his paper here, expressly to bring out that point. Although I had some idea of it myself, yet I did not think it was quite clear. He says:—"It may be said that a certain quantity of "heat is wasted in generating this steam, but that heat is made available again. "Now, that depends, I may say, almost entirely upon the temperature at which the "steam is used. You expend a certain quantity of heat in evaporating water, and "you send the steam in at a comparatively low temperature. In the ordinary state "of saturated steam, the temperature of that, as compared with burning fuel, is "cold. It may be very hot as compared with the ordinary temperature of the "atmosphere; but as compared with the temperature of the fuel in the furnace, it "is a very low temperature indeed. A body cannot give out heat to a body that is "hotter than itself, so that the heat spent in producing steam at a comparatively "low temperature will be wasted; but if you use superheated steam, in the first

"place, a much less quantity of steam will serve the purpose. The mechanical "effect depends upon pressure and volume. In order to get a great pressure and a "great volume with small weight of material, you must employ a high temperature; "you must, in short, use superheated steam. As a great part of the expenditure of "heat in producing the steam depends on its weight, the use of superheated steam "tends to lessen the expenditure of heat for a given mechanical effect. Then, if you "raise the steam to a temperature approximating to that of the flame itself, you get "back nearly the whole of the heat again; because the superheated steam, being "at a higher temperature than the heating surface of the boiler, gives out a great "part of its heat to that surface, just as the flame does." The extraordinary fact the gallant Admiral has also remarked upon, that when you hold your hand to superheated steam it seems cold. [Admiral CODRINGTON: I meant high-pressure steam.] High-pressure steam, after a certain pressure, assumes the character more and more. Latent heat exists, or heat which does not seem to be developed in the way in which we apply our hands to it. But I think, as far as I am aware, the explanation of the question of the cold feel, is the induced current of air around you. Certain it is that there is a cold feel to the hand; that you do not scald your hand with high-pressure steam as you do with what the Americans call "stam," or with steam at lower temperature. But it is necessary for the heating power of that apparatus, and for that of any apparatus, first that the steam should be superheated to avoid the great loss of steam which will be the result of producing the same mechanical effect, with a lower temperature; and next, in order that a complete separation of gases, the hydrogen, the oxygen, the superheated steam, should be able to take place at the point without any deposition of water, and that the oxygen should be completely taken up where it is wanted.

Admiral CODRINGTON: Perhaps I may say that I held my hand very close to the jet: but I could not hold it two or three inches off.

Captain SELWYN: As soon as the pressure begins to lower, the heat is felt. With regard to the fire-brick, I was not quite understood. I did not say this was a correct representation of the furnace as it is always used. But more or less of fire-brick may be put in. If you fill the whole of this space under the boiler to the top with fire-brick, piled so loosely as to leave interstices, the whole mass will become of a glowing white heat. With regard to creosote, it is just what people choose to call it. People call things by so many names. This in my hand is called "dead oil of tar," "dead earth oil," "creosote," "acid foots," and I think half a dozen other different names by different people. The fact is, it is the refuse distillation of the illuminating oils, and the refuse of gas manufactories. Pits have been dug in the earth, and hundreds of millions of gallons buried annually in the British Islands, besides what is similarly wasted over the whole world. It could be produced in any amount required in any part of the globe, and at very little, if at all enhanced price. There is no possible fear of the exhaustion of the supply—and I am now answering two inquiries—neither is there any possible fear of a rising price beyond that which will suffice just to make it compete with coal. We must not expect that our friends who have dead oil of tar to sell will consent to sell it for nothing when they find it is worth something. The next question was Mr. Richardson's, about his boiler burning creosote. I have carefully guarded myself against the question of any one boiler being better than another, or anything of that kind. That I know nothing about, except that I have chosen a particular apparatus, which I prefer. Mr. Richardson's boiler seems to have done very good duty with creosote; but not quite so good as we have been able to obtain elsewhere. I am happy to hear that his boiler has done so well with it. While Mr. Richardson was making his observations, I took the trouble to light a little more of this creosote, which he says leaves coke. It has burned off as clear as it can possibly do; there is no coke here. We have never got coke. After six months' firing, Mr. Field will tell you, there was no residuum of coke. The creosote came into the factory in barrels, it did not come out at the bottom, the whole did burn somewhere, and as it is not apparent in the furnace or in the ash-pit, I conceive it must have vaporized and gone out of the chimney. The great thing for people who wish to burn this oil properly, will be to understand that simple alphabet on the wall; there is nothing more simple, and if

they will take the trouble to go over it two or three times, they can easily master the chemical equivalents, and the way in which they ought to burn the oil. The way to do it is certainly not to sacrifice the hydrogen; that is one thing which I totally repudiate. When I see that hydrogen gives 64 units of evaporation against 15 to be obtained from carbon in most favourable circumstances, unless it be a gaseous carbon, then I say that it would be a perfect folly to drive the hydrogen up the chimney, and think I was well rid of it. Mr. Mackie asked me if rapid firing had been tried. I do not quite understand what he means by rapid firing in this instance, because with oils the thing is to get them into active operation as soon as possible.

Mr. Mackie: I will endeavour to make clear what I wished to convey. It was this: suppose it takes a given quantity of steam to drive a steamboat at a given rate per hour, you must find steam at that rate, cost what it may. If you take the experiments which I have seen at Woolwich, and at other places; the experiments have been conducted on this system—you take a pound of oil; you burn the pound of oil out, and you calculate at 10 lb. pressure in the boiler the amount of water which has been evaporated by that pound. It may have taken six hours, ten hours, or a day, to have evaporated so much water by so much oil; whereas in steamboats you must get as much flame as you possibly can; you care nothing about the waste that goes out of the funnel, but you raise so much steam by so much fuel in a given time. Now, the point of my question was whether—given you had to get steam up at a considerable amount of pressure in your boiler—you could burn oil in the furnace rapidly enough, securing its perfect combustion, to raise the same quantity of steam in a given amount of time? You are aware that at Woolwich the coal boiler is made the test of the quantity of water a pound of coal will evaporate, and also the quantity of steam that can be evaporated in a given time. I do not know whether the oil has been tested against the coal to raise steam in a given time.

Captain Selwyn: The time given for raising steam in the most carefully tabulated experiments I have at command, was twenty minutes; but I am confident that with a good boiler, and proper means of lighting with the mineral oil—by a good boiler I understand a rapidly circulating boiler, for no other boiler is good at raising steam rapidly—with a good boiler on a proper circulating system, I have no doubt the time may be brought down to fifteen minutes at the outside.

Mr. Mackie: In raising steam?

Captain Selwyn: In raising steam to the pressure required, whether that be 60 lb. on the square inch, or only 20 lbs. It will then go on without the slightest intermission as long as you choose to supply oil to that boiler. Of course the boiler will be proportioned to give so many cubic feet of evaporation for each horse-power you require from it. That evaporation can be obtained very favourably, because, as no carbon is deposited, as in coal, it will be more constant than with coal. There was a question by Captain Colomb, about lighting up, which he said he did not understand. There are several modes of lighting. The mode of lighting constantly pursued under this boiler, because it was an ordinary Cornish boiler, which could not be supplied with any extra apparatus, Mr. Field will give you an explanation of. That is the experiment which was made by Mr. Field. I have another suggestion to make as regards lighting. It so happens that we know that a mixture of any of those oils with alcoholic mixtures renders them more vaporizable, and also banishes the smoke, and so we get perfect combustion. We may, therefore, use a mixture of alcohol to produce the effect of lighting a boiler in a short time. But I think that these will be allowed to be minor questions, when we come to consider the enormous facilities which the regular use of these oils will give. Mr. Olrick's observations on the boiler he saw, are simply what I expected from the construction of the boiler, and from the nature of the general combustion under that boiler which I have seen or heard of. There has always been at first a large quantity of smoke generated; the tubes became thickly coated with soot; they never entirely recovered their heating power, and, therefore, that boiler never did the duty which could be got from it. That is to be regretted, but I have no doubt the difficulty is to be overcome. The question is whether it was the same apparatus? You might take this apparatus as I might take this gas lamp. I can make it play all kinds of

tricks. If I give it too much air—a little too much will do the business entirely—it will spoil the whole combustion. I can clearly show that the least excess of air, from a mistake as to the quantity of air to be admitted, or the size of your tubes, or the character of your steam, will cause imperfect combustion, and will result in smoke. That does not invalidate the character of the apparatus, which, I consider, has shown its satisfactory results too often to be doubted in any way whatever. At least, I am thoroughly contented with it. I do not know that I can tell you anything further now, only to say that I shall myself hope to be prepared to speak of experiments conducted, as I believe they will be practically, by the kindness of the Controller, under my supervision. As is mentioned in Colonel Foote's pamphlet by Mr. Stimer, who seems to be a clever chief engineer in America, as has been done in that instance, so shall be done at Woolwich under my superintendence; if I am allowed to superintend, with my friend Mr. Trickett's assistance, a very accurate, close, scientific calculation shall be made, of every pound of fuel used, every second of time employed, of every iota of result obtained. That shall be at the service of every one to whom I may be permitted to give it by the Admiralty.

The CHAIRMAN: Now, Mr. Field, will you be kind enough to explain the point of lighting up under the Cornish boiler?

Captain BURGESS: There is one question that I put to Captain Selwyn.

Captain SELWYN: About the alteration in the boilers now in use in the Navy. I think I adverted to that in the paper. No alteration need be required. It is only a question of making the boiler better than hitherto. The same boilers can be used, with the same furnaces, with the same everything. They will require some closing up of the fire-doors, and the adaptation of the steam-pipe in front; and they will require, probably, the putting in either fire-brick or some material to absorb the heat, but no other alteration of any kind need be gone through.

Mr. FIELD: The furnace that Captain Selwyn alluded to, was simply lighted by taking burning coal and placing it on the grate.

Captain SELWYN: What quantity?

Mr. FIELD: A couple of shovelfuls of lighted coal placed on the ordinary grate. Then steam was turned on from another boiler, and the petroleum or creosote merely injected by the force of the steam. That produced a brilliant flame, which, after blowing for about 35 minutes, generally raised the steam to 8 lb. or 10 lb. to the square inch from cold water. As soon as the furnace became thoroughly heated, the proper combustion took place, the whole of the light disappeared, and the gas burned with a reddish-blue flame, perfectly transparent. There was not the least smoke nor deposition of carbon. There was not the slightest carbon left.

Captain COLOMB: Perhaps Captain Selwyn will say finally whether it is intended to employ a second boiler in order to supply the steam that has just been described for the lighting.

Captain SELWYN: I have given several modes by which the lighting may be done without the use of any donkey-boiler; but I would say he would be very foolish who did not use the steam from his donkey-boiler for the purpose when it is near at hand.

The CHAIRMAN: As I believe all the gentlemen who wish to make any remarks have said all they have to say, I have now to close the meeting by calling upon you to thank Captain Selwyn for his very able and elaborate paper. Before doing so, however, I should wish to make one or two observations. Since the last time that this subject was discussed here, some experiments have been made—I think in 1866—with a boiler on Mr. Richardson's plan. I will not go into the details of all those experiments, or their results; but I cannot help thinking that my friend, Captain Selwyn, takes rather a sanguine view of this subject. It is quite clear that we are on the threshold of the employment of mineral oils for fuel. I trust that he and others who have taken up the subject will persevere in their investigations. Of course, in introducing new fuel of this peculiar kind, great difficulties will have to be surmounted; and I trust that by his perseverance, and that of others, the results which he sanguinely expects, may be realized. But in his observations I think he assigned too low a duty to coal. He put it at 7 lb.

Captain SELWYN: 7·5 lb. is exactly the duty done in the best American steamers.

The CHAIRMAN: I have in my hand a Report by the Chief Engineer of the Navy. A duty of 10 lb. can be obtained.

Captain SELWYN: You never get it at sea.

Mr. OLRICK: Sometimes it is only 5 to 6 lb.

The CHAIRMAN: At Woolwich, a duty of 9½ lb. is got in the trial boiler, which should be used for the comparison.

Mr. RICHARDSON: They only produced 6¾ lb. with coal.

The CHAIRMAN: I am afraid, Mr. Richardson, your memory is fallacious.

Mr. RICHARDSON: It was 6·75 lb.

The CHAIRMAN: I should be sorry to state anything incorrectly, because I am not in the least an opponent of this fuel; I am only stating what is stated in this document.

Mr. RICHARDSON: It was 7¼ lb. the first day, 6¾ lb. the next day, with the very best Welsh anthracite coal.

The CHAIRMAN: I must be allowed to read one line: "It must be observed, however, that the evaporation in this coal boiler is low, namely, 8 lb. of water per lb. of coal. From 9 lb. to 9¼ lb. of water per lb. of coal is, when carefully burned, more nearly the result obtained in the marine boiler with the Welsh coal, or with a mixture of two-thirds Welsh and one-third North country coal."

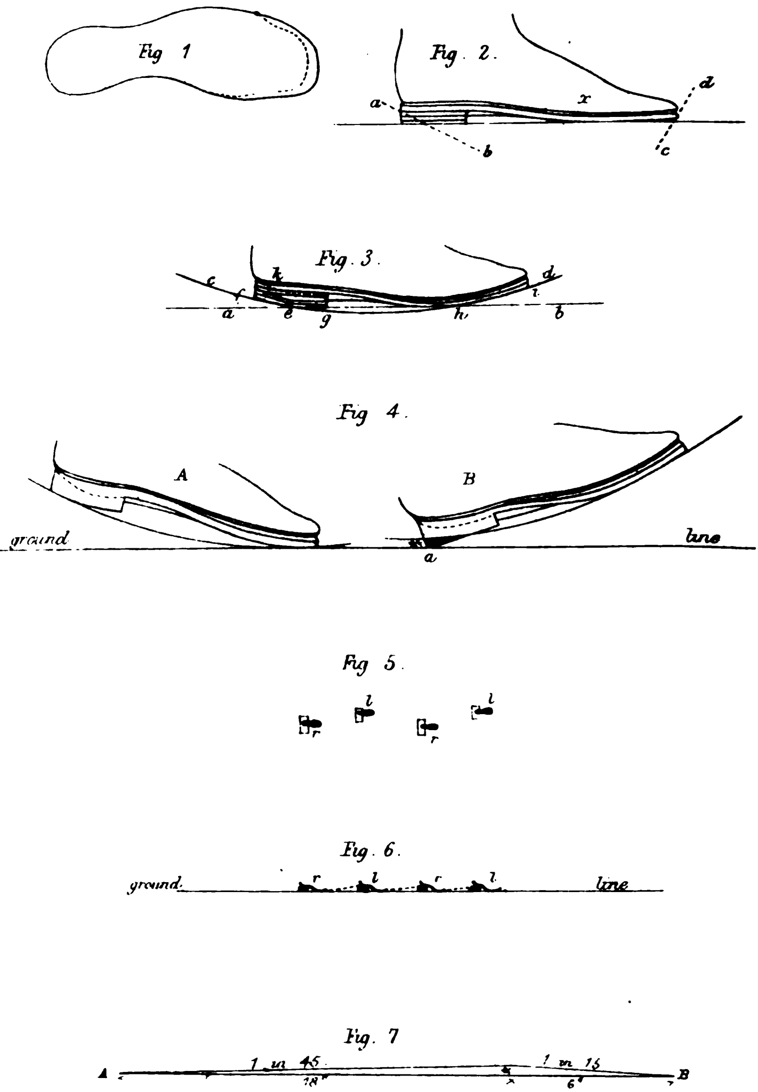
Mr. RICHARDSON: That boiler was the experimental boiler at Woolwich, the very best boiler in England. It will do more than any other.

The CHAIRMAN: It shows what a good trial-boiler it must be.

Mr. RICHARDSON: It is; but the boiler that produced 6¾ lb. was that of the "Teazer" gun-boat, which they made me use.

The CHAIRMAN: However, whatever may have been the results on that occasion, I certainly hope that this question of burning mineral oils will be prosecuted, and that in the end, it will be successful. For if we can get the same amount of steam, and reduce our expenditure of fuel 2½ times; that is to say, gain it in stowage, I am sure we shall all be delighted. I have only to add that Captain Selwyn has met with a very severe accident, and has hardly recovered from the effects of it yet; I am sure that this is an additional reason for giving him our hearty thanks for reading this paper.

Construction of Boots



J. Jobbins.

shoemaker made it of the form that he considered elegant, and left the wretched foot to adjust itself to the shoe. To get rid of this torture, my feet called upon my head to do its duty; and, accordingly, I studied how a shoe should be constructed both in plan and in cross and longitudinal sections.

To learn how to form a shoe, I studied an old pair, so as to gain hints from nature. To obtain the plan or outline of the sole, I set my foot flat on a sheet of paper and drew a line round it. The result was the form shown in Fig. 1, Plate III, from which no deviation should be allowed except to vary the toe a little in compliance with fashion, which ordains that the toe of the shoe shall be round, square, or pointed the alteration to be external to the outline of the foot. I then obtained two common lasts, and nailed pieces of leather on to some parts, and cut the wood away in others, until one last coincided with the outline on one side of the paper, and the other last with the same outline when traced through on the back of the paper. As regards the longitudinal section, I made the toe of the last bend up to the same curve which the old shoe had acquired; and I ordered my shoemaker to make the heel of the shoe bend up behind, to the same curve as that to which the heel of the old shoe had worn itself. This outer curve I found to be parallel to the curve of the living heel, and should be at the same distance from the heel as the bottom of the sole is from the living foot. In thus copying the old shoe, I did no more than a mechanical engineer does in forming the cogs of wheels. He does not arbitrarily cast the teeth, sharp and square, but he casts them at first in the forms to which the cogs would mutually grind themselves after long wear and tear. If, too, the inside of the sole of an old shoe be observed, it will be found like a cast of the under part of the foot, in which a hollow will be noticed, caused by the pressure of the great toe; this also should be taken into consideration when making a new last.

The transverse sections, or measures of the foot, are simply taken with a strip of paper in the usual way.

Marshal Saxe declared that the success of a campaign depended more upon the legs than the arms of the soldier; and the Duke of Wellington, on being asked what was the best requisite a soldier could be provided with, replied—"a good pair of shoes." We may then assume, that suitable shoes bear a greater proportion in value, as compared even with the weapons with which a soldier is armed, than is usually considered the case. In like manner, suitable shoes are of greater importance to the public generally than would at first be supposed.

Having arrived at what I believed to be the true principles on which shoes should be constructed, and having verified those principles by my own long experience, and knowing the tortures suffered by the Army and by the public in consequence of ignorantly-made shoes, I determined to publish my ideas. Accordingly in the *Mechanics' Magazine* for July, 1856, No. 1,717, and March, 1857, No. 1,755, will be found two papers of mine on the "Construction of Boots and Shoes," the latter of which was written with special reference to the wants of

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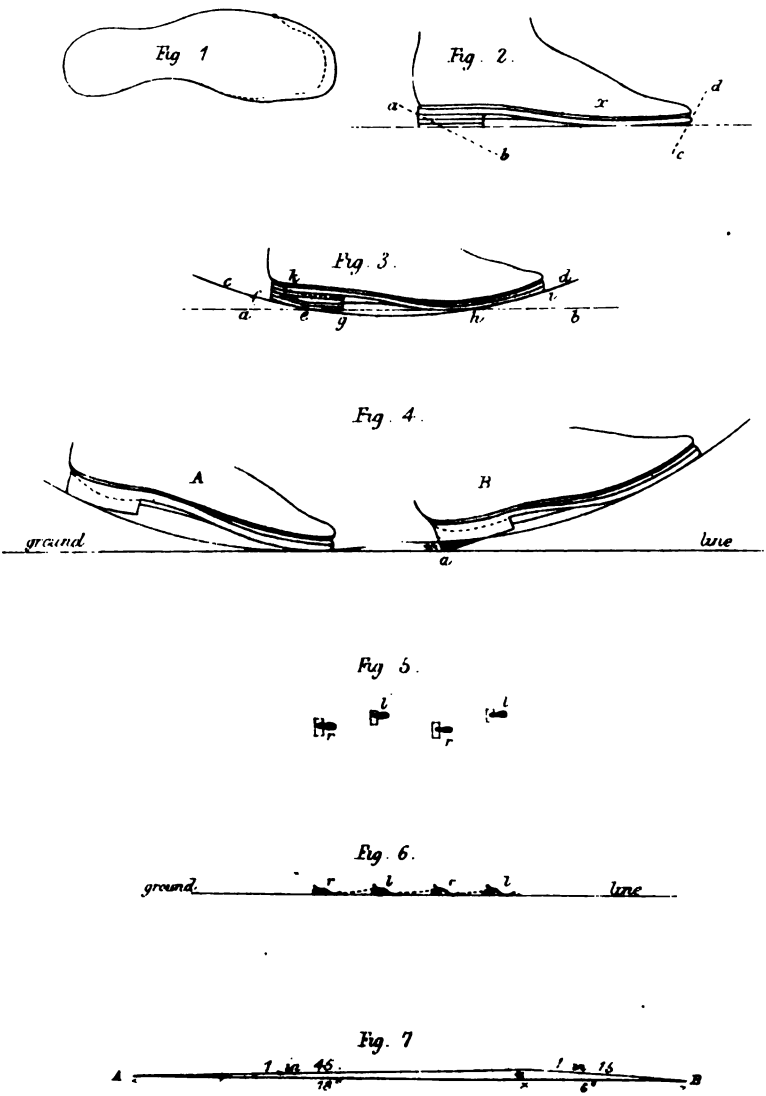

Jobbins

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the Army, but it applies equally to the police, and to the working classes.

Copies of these numbers of the magazine, with additional information and drawings, full size, I forwarded to the War Office. In reply, I was informed that the Inspectors of Boots considered my ideas quite contrary to all the rules for bootmaking, and that Fig. 1 was a "perfect fallacy." At any rate, this reply shows that what I proposed ten years ago, was then quite new and strange to the Army Clothing Department.

I began my first paper by saying, that while there are treatises on shoeing a horse, I had never met with any rational observations on the best method of shoeing a man. This was in 1856. In 1858, a pamphlet on shoes was published at Zurich, by Dr. Herrmann Meyer, of which an English translation was published in 1860. In 1863, an admirable pamphlet on shoes, by Dr. Günther, was published at Leipzig. Now, in both these foreign works, the diagrams showing the proper principles on which the soles of shoes should be cut, are identical with my Fig. 1; not that those learned professors of anatomy copied from me, but it is plain that their knowledge and common sense led them to the same conclusions at which I had arrived. But neither of those writers showed what the shoe should be in longitudinal section. They left their work only half done.

When the Army Clothing Department was removed from Weedon to Pimlico, and placed in charge of a new Officer, I raised the question again by sending in my paper as before. This time I received the following in reply:—"I return these papers and the two magazines, "with thanks. The principles on which Mr. Howlett proposes to "make the shape of the shoe are undoubtedly good. We are now "endeavouring to get the authorities to adopt similar principles, and "believe we shall succeed.

"(Signed) C. B. DAUBENY, Col.

"Pimlico, 1 May, 1861."

Happily these principles, as regards the shape of the sole of the shoe, were adopted; and the outline of the sole of the present Army boot is identical with that proposed by me in 1856 and 1857, though at the time it was considered to be a fallacy. I think I may therefore fairly claim the credit of having been the first pioneer in this great Army question.

My suggestions as regards the longitudinal section, or side view of the shoe, as shown in Fig. 3, have, however, not yet been understood, and they still stand rejected because they are considered to be contrary to all the rules for bootmaking; this is very true, for I have never seen or heard of anything of the kind before. My method of forming the heel, as published in 1856, is perfectly original, and I am content to bear the ridicule raised against it, until I can get the credit which I believe it will be found to deserve.

As stated above, it is admitted that I was right in what I proposed in 1856 and 1857 as regards Fig. 1; and I will now attempt to demonstrate that I was equally right as regards Fig. 3, as shown more fully in the annexed plate, and that the advantages of forming the

heel in particular, like Fig. 3, instead of like Fig. 2, are of greater practical importance than would be supposed.

Fig. 2 is a side view of a boot, showing the construction that is universal, whether for clumps or for light boots. The heel is composed of horizontal courses of leather, intended to stand perfectly flat on the ground; and at the toe, the sole nearly touches the ground. The Army boot is made on the principle of Fig. 2, having the heel strongly shod with iron, and the toe a little more raised.

But, that Fig. 2 is not the natural form, is proved by the fact, that, in walking, an immediate effort is made by nature to get rid of the part of the heel below *a b*, and also to rub off the tip of the toe at *c d*, if the sole is not sufficiently flexible to bend up with the foot.

As in walking the front part of such a shoe as this requires to be bent upwards, the superfluous leather folds and creases across the foot at *x*, and is liable to crack there. Fig. 2 shows the principle upon which boots and shoes are made everywhere, I may say, by all nations, for the Secretary drew my attention to the cases in the rooms above in which there are specimens of the boots issued to the different armies of Europe, and also to that of the United States. They are all upon the principle shown in Fig. 2. They generally stand on a flat surface; the heel coincides with that surface, and the toe is more or less bent up. You will see in all the principal shops in Pall Mall, in fact in those of all the principal bootmakers, splendid workmanship as regards the stitching, and excellent leather, &c.; but you will find that this is the mode of construction. Of course everybody knows after he has walked a few weeks in a boot of this sort, that the heel immediately begins to cut away in the direction of the line *a b*, and it keeps going in that direction until it gets ragged and torn; and then it requires to be mended. Then you have it mended, and nature goes to work again; and when the heel is cut away so as to be unsightly, the boot is thrown on one side; so that from first to last you are defeating what nature attempts to do by cutting away the heel. If the boot is not sufficiently flexible, the toe is next worn off, as shown by the line *c d*. If the boot be flexible, so that when you step it bends up to take the proper curve, the leather has to fold up, and by this folding up, a crack comes, and finally you get a most unsightly split there. All this is owing to what I consider bad construction. Our wisdom in everything is to try to copy nature, to follow that fine mechanism which every work of the Creator exhibits; we should look around and see how nature works. Nature is very friendly to us if we will but follow her lead; but we won't do that, we won't take the hint about the heel, nor will we take the hint about the toe.

To obviate these and many other objections, my boot is made like Fig. 3. *a b*, is the ground line; *c d*, an arc, about 20 inches radius; *e f*, part of the heel made to coincide with the arc *c d*; *e g*, rest of heel left quite flat, and in a line with *e h*; *h i*, part of sole, made to coincide with the arc *c d*; *k*, hollow to receive heel of foot, which is on a level with the sole; thus both feet always stand and walk on the same plane, though the heel appears outside to be much thicker than the sole.

In principle, the height from the ground to the living heel should

not exceed the height from the ground to the living toe. It is not important to go to the twentieth part of an inch, but in principle we should endeavour to stand upon a level surface; though the foot is in the boot it should still be parallel to the ground. The heel here looks very thick, but then the living heel fits into a hollow in the heel of the boot, and I do not care how thick the sole and how thick the heel may be, provided you do not break that condition, and make me walk on two planes, and provided you give me those curves on which I can roll along without my really knowing upon what plane I am. In action, when the foot is thrown forward, it rolls on the curve *f e*; it then stands flat on *e h*; and then, when leaving the ground, the foot still rolls on the curve *h i*. Hence the person always rolls along on the arc *c d*, instead of jolting along by an up and down and transverse action, as caused by the construction of the shoe shown in Fig. 2, which action I will proceed to explain.

And here I come to something very curious. I have never heard the idea stated before, and as there are mathematicians present, I shall be much obliged if they will watch and see if they can detect any flaw in my argument, any mistake in my calculations. In Fig. 4, A is the foot just leaving the ground, and B, the foot just striking the ground at *a*. The part shown in black at *a*, is, as will be noticed, added to the shoe of my construction to make the heel like the usual heel, which in this part is square, like Fig. 2; and we see that it forms, what a carpenter would call, the riser of a step, requiring the foot to be lifted up about ·4 inch above the ground plane. But if we suppose the part shown in black, at *a*, to be removed, then would the heel of my boots strike the ground at once, on the same level as the toe of A. I may say here that I have taken these proportions, the curve, and so on, from my own boot, including the four-tenths of an inch. Perhaps some other persons would wear that portion down half an inch, and others three-tenths, but I should think that, as I am a man of a middle size, four-tenths of an inch would probably be the riser of my step. It will be seen and understood with a little reflection, that by giving a curve to the heel, as shown in Fig. 3, we get rid of the riser, which occurs at the end of every step the wearer takes. But then, as my step, for instance, is only 24 inches, and the riser ·4-inch, we have a considerable slope, so much so that in ten miles the total of these risers would be 880 feet upon a slope of 1 in 45; and as much down, upon a slope of 1 in 15, as before stated, all of which is waste labour and owing to the false construction of the heel (see Fig. 7).

The following experiment, if actually tried, or only imagined, will show the exact action of a person wearing a boot like Fig. 2:—

Select some books, each nearly half an inch thick, and place them on the ground 24 inches apart, as shown in Fig. 5. Now, with your boots off, step along, putting your heels on the books, and then you will go up and down, as shown in Fig. 6, and at the same time your shoulders will rise and fall. All this causes a grinding friction, especially on the ankles, cruelly intensified when a man has to carry a load. I expect it will be said that a rise of even half an inch in a step

is not much; but then, in ten miles, this rise and fall is repeated 26,400 times.

You see it is a small step, but when you multiply that by 26,400 it comes to the very neat little figure of 880 feet. Now, to go up a hill 880 feet high when it is not necessary, is certainly not a desirable thing for a soldier. If you put a load upon a man's back—I do not know how much a soldier's accoutrements and arms weigh, but I should think it would be 50 pounds—when you put that load on a man's back the desideratum is to send him on as easily as you can without any jerks; because every jerk intensifies the blow, it doubles the weight, and it gives a friction upon every joint in his system. To take a metaphor from the spokes of a wheel; you have seen an old cart which has come to grief, with the felloe off two or three of the spokes. The wheel goes smoothly round on the sound part of the circumference, but when it comes to the bare spokes without the felloe, it jolts and rattles everything inside the cart, and tends to shake the whole fabric to pieces. That is exactly the case with a man if he walks along in a jerking, jolting way; it shakes and grinds every bone in him, and that causes weariness. Suppose the line A B, in Fig. 7, be 10 miles in length; a person wearing a boot like that in Fig. 2, going 10 miles from A to B, would go over a hill, 800 feet high; but a person wearing a boot like that in Fig. 3, would go along the level line. So that a person unwittingly, in wearing a boot like that in Fig. 2, which is the boot every sportsman and everybody else wears, would go along the hill when he thinks he is going along a level road. Instead of following nature, which guides you so kindly, you ignore her; and you won't go along the level plane, but you will go over the hill; and the consequence is there is that waste of labour. I am one of the last men who would wish to intrude myself upon others, or to animadvert upon what they do, or to interfere with departments, or with other people; but I think I am justified in stepping out of my way just to submit to your consideration whether there is truth in this statement or not. It is a matter of calculation.

In a shoe like that in Fig. 3 the least possible amount of friction is caused, because the shoe is only pressed down on the ground, not rubbed against it, and, therefore, lasts much longer. I think I may say that two pair of shoes like that in Fig. 3 will last longer than three pair like that in Fig. 2. At present the difficulty is to get shoes made like that represented in Fig. 3. Being desirous of trying experiments with iron heels, I bought a pair, and ordered them to be bent to the proper curve for my purpose; but though the workman had clear instructions, he hammered them flat. I, however, a year or two before, had got a pair of curved irons put on a pair of boots, and can now show you the different way in which the flat and the curved wear. The flat have worn in the direction of *a b*, in Fig. 2; but the curved have worn equally all over the surface, till the whole of the iron heel is reduced to the thickness of a card, without being broken through. These boots had had very hard wear indeed—the hardest wear by the sea-side and in the country. I believe they are five years old.

The usual way in which iron heels wear is this. The back part wears away, as shown at A B in Fig. 2, before the sides are worn through. After a time the heel gets worn down on the outside—it gets lopsided—all owing to bad construction. I think I have demonstrated in my boot what nature means. Nature does not object to the iron heel, provided it follows the curve of the living heel. This boot has been in hard use two or three years, and the figure of the heel is just as good as when it was first made; there is not the slightest displacement; it is as sound and as solid as ever.

To save labour and to save money are both so desirable that when once the world finds out the truth of the matter, I predict that boots and shoes made according to that in Fig. 3, as well as in Fig. 1, will gradually become universal; and in years to come, it will be hard to believe that boots and shoes were ever made on any other principles than those now submitted; they are not submitted as matters of opinion, but as matters of fact, founded on experiments, mathematical reasoning, and long experience.

From the specimens of shoes exhibited in the windows of the principal shoemakers, both in town and country, it is evident that the question of how shoes should be formed has never been studied in the kind of way which the foregoing remarks suggest. It does not appear that shoes are anywhere in this country kept on sale that are made to fit the foot, as suggested in Fig. 1; of course not according to Fig. 3, because it is new. I have, however, in some places, seen approximations to the cut of the Army boot.

But I would anticipate what strikes people as an objection. From a hasty glance they conclude that a shoe formed as suggested, would have a crooked inelegant appearance. The fact is quite the reverse. The sole is not seen, being of course under the foot, while the upper part of the shoe being an exact fit, without either unequal pressure, or any waste room, exhibits the foot in its smallest possible size, and gives it a neat, compact, and finished appearance. Under any circumstances, this mode of cutting the sole makes the best of the foot as regards its appearance; and, if adopted in early life, the foot would be preserved from those distortions which cause it pain and make it unsightly in after life.

It has been objected, that shoes intended to be kept in stock for general sale, could not be cut from actual plan of the foot as proposed: but surely it is just as easy to keep a stock of shoes of various sizes with the soles cut according to the proper type of the human foot, as to keep them ready in any other form. Nor would the form proposed cause waste of leather. To form the heel as proposed would be very easy.

I do not wish to make any observations upon what other people do, for I think it is a wise maxim, that the very best comment upon error of any kind, is just to state the truth, and leave other people to apply it. Here is the Army boot. I make no observations about it, but if I had my own way, instead of having the heel square, I should make the iron heel bend and turn up as I have pointed out. I should simply make the heel upon my principle. I trust that I shall not

give offence to any gentleman in the Clothing Department, who may chance to be present. I think what I have said is perfectly fair, and not at all offensive. This alteration can be made without any additional expense; it is simply to work it to the form I propose, and if my argument is correct, the making that little alteration, would save men the labour of going over the hill I have before mentioned. I submit to the Chief Officers in the Army whether it should not be seen to with a view to the comfort of the men.

In most trades considerable ingenuity is shown, and there is a rivalry to produce the most perfect articles. Even the tailor aspires to cut upon geometrical principles; and then having made sure of a perfect fit, he does what may be possible to give elegance to your appearance. But the master shoemaker seems to have no such ambition. Either he brings not the least ingenuity or common sense to bear upon his trade, or else he offers shoes of a form that he thinks will flatter his customers. The shoe he sells, is a fancy formation, in which the form of nature is ignored. It is very seldom that we see the true form of the foot at all recognised, and when we do, it is, I think, in shoes of foreign make. All the shoemaker does is to order certain lasts to be cut according to fancy forms which he is pleased to call "the fashion." Upon these he orders shoes to be made; and certainly the neatness and elegance of the workmanship, so far as closing and stitching go, are wonderful. But then the shoe does not fit the foot, and instead of ease you get torture. When the shoe is first forced on, it may be noticed, that while the foot points one way, the shoe points another, with part of the foot overhanging the sole. The result is, that while on one side the edges of the sole and heel are hardly worn, the edges on the other side are worn to nothing, and you finish by walking on the upper leather.

It has long been a rule with me, never to find fault with what other persons do without first being prepared to state definitely what I would do myself. In 1856 I found fault with the Army boot; and the principles I submitted for its reform having been found undoubtedly good, they were carried out, except as regards the formation of the heel. I now again show how the heel should be formed, and I show the reasons why. I now say that the whole trade of shoemaking is in certain respects wrong, and should be reformed according to the principles shown in Figs. 1 and 3.

Three years ago, I was shown a private letter from a distinguished Officer, in which he says that, "in 1820, his boots caused him much "misery, when out shooting; to remedy this, he trod with his whole "weight on a sheet of paper, traced on it the breadth and twist of his "foot, had a last made therefrom, and the result was, the difference, "in walking, between purgatory and paradise; and that he thought "that the system would be particularly valuable to the Army." But then, as it does not appear that the Officer published his ideas, as I did mine, ten years later, neither the public nor the Army have had the benefit of his experience.

Now, seeing that the form of sole shown in Fig. 1 has been adopted by the Army, has been advocated by two foreign writers, and is recom-

mended in such terms as above quoted; and seeing that the principles shown in Fig. 3 may be considered as unanswerably demonstrated, it is, I think, a pity that my boot complete is not somewhere on sale.

It appears to me that if the Civil Service Association were to have a stock of boots and shoes made upon the foregoing principles, it would promote both comfort and economy among many of the members of the Service; and that it would be of especial value to postmen, who walk ten or twenty miles a day, and are frequently laid up in consequence of being footsore, no doubt occasioned by the faulty make of their shoes. Surely twenty miles a day is a sufficiently severe task for our friend the postman, without subjecting him to a waste of labour equal to going up and down a hill a thousand feet high as before explained.

The Chairman: Gentlemen, it is impossible to deny the justice of the dictum of Marshal Saxe, that in the great operations of the field, the success of an Army depends more upon the legs than upon the arms of the soldier. If that be the case, it is of as much interest to study what will tend to the soldier's means of locomotion, as it is to attend to the rifled guns and other implements of war. Therefore I think I shall not be wrong in conveying to Mr. Howlett the thanks of this meeting for his paper and remarks upon a subject of so much interest. I have the greater pleasure in doing so, because I happen to have been associated with Mr. Howlett in the same branch of the War Office, and I can bear testimony to the ability, zeal, and energy shown in his great labours for the good of the public service, and during a very lengthened period.

Colonel Daubeney, Inspector of Army Clothing, Pimlico: I merely wish to make a remark in consequence of Mr. Howlett having by accident taken up the wrong boot, viz., the old Army boot, which has been obsolete at least, 8 years; it is not the Army boot of the present day, nor anything like it. I have placed on the table a boot taken out of a lot delivered by one of the contractors this day, showing the pattern which is now worn by the Army, and the last on which it was made, is with it. You will observe that they are pretty nearly on the same principles, so far, at least, as the toe goes, and the socket for the ball of the foot also, as Mr. Howlett's. These patterns we have had in use at Pimlico for a long time. Of course everybody has ideas upon shoes, but I may say that these alterations were made by myself, with the assistance of a very clever Officer of the Department, and were in progress—Mr. Howlett will excuse me for saying so—long before I made his acquaintance, having myself, as an Infantry Officer of thirty years' standing, repeatedly tested their merits. In fact the patterns of these boots were the result of my experiences in India, and I matured them as far back as 1848 to my own satisfaction. It is only fair to the Clothing Department to say that *this* is the Army boot of the present day, and not *that* one which Mr. Howlett showed. Here is also a zinc pattern of the sole; I think it is very much like Mr. Howlett's. The way I arrived at this, was that I got 100 men of the Guards down at Pimlico, and took a model of the *tread* of every one of their feet, and that is the result.

The boot I have now alluded to, was delivered by one of the contractors this morning, I took it out of the lot and brought it down here as a specimen of what is now actually issued to the British soldier.

Mr. Howlett: You will observe that the heel is quite flat; and as that is what I wanted to prove, I am glad that a boot is produced from the last supply. It appears to be an excellent boot. The sole is like Fig. 1, and if the heel were bent up like Fig. 3, then I think the boot would be perfect.

Colonel Daubeney: I attach no importance to a bevelled heel (proposed by Mr. Howlett) for a soldier's boot.

LECTURE.

Friday, February 28th, 1868.

Vice-Admiral SIR ALEXANDER MILNE, K.C.B., Lord Commissioner of the Admiralty, in the Chair.

THE NAVAL DEPARTMENT OF THE FRENCH INTERNATIONAL EXHIBITION OF 1867.

By Commander P. H. Colomb, R.N.

My first introduction to the Paris Exhibition was in this wise. I had received a pressing notice from South Kensington to the effect that if intending exhibitors were not at the building to claim their space by a certain date, it would be used for the general purposes of the Exhibition. So, a day before that date I proceeded to Paris, and found myself in a large open area, partly floored, in search of an official from whom I might learn my position. In a corner of the main building I found him, and said—

"Will you kindly shew me my space?"

"Let me see," said the official, "what Class do you belong to?"

"Class 66," said I.

"Oh, poor 66," said the official, "come with me and I will shew you."

I followed him out of the building, through the mass of bricks and rubbish which then represented the park, through a subterranean passage deep in mud and filth, and finally out on to the bank of the Seine. Here we found the framework of a very large shed, partly roofed in, with a floor like a mud flat when the tide has ebbed. There was a fair sized pond in the middle of it, and some lesser ones scattered about.

My conductor walked over to one of these lesser ponds, and pointing to it with a grave countenance, said—

"This is your space."

I had come over in a great hurry and at some inconvenience to claim my space, and was not very well pleased to find a pond set apart for my especial use. I stood looking at my pond with a rueful countenance.

"It will be all right by-and-bye if the river does not rise again,—it generally rises once or twice before it finally subsides," said my conductor.

This was so satisfactory that I gave up all hopes of any result, and merely pointed to the large pond in the middle, saying—

"Whose space is that?"

"That's for Penn's engine," said the official.

My second visit to the Exhibition was some six weeks after this date.

Again I found myself in the large open area of the main building, now filled with many workmen, hundreds of cases, some closed, and some with their contents half out.

Again I sought out my friendly official, and this time my request was—

"Will you kindly tell me where I shall be likely to find my cases?"

"Let me see," considered the official, with his hand upon his chin, "what class do you belong to?"

"Class 66," said I.

"Oh, poor 66," he murmured. "Come along with me and I'll try and find your cases."

But we searched all that day and several succeeding ones, without meeting with but one case containing apparatus, and that had found its way into the haberdashery department. My space, and that of most English exhibitors, in Class 66, was still a mud flat, and the consequence was, that the cases of that class were necessitated to find successive resting places in the main building, sometimes made use of as scaffolding and platforms by practical exhibitors determined to make the best of things, but more often sworn at and viciously pushed out into the tide-way of traffic, where the "Manutention" might seize upon them and bear them to a temporary rest on the territory of some more complaisant exhibitor.

From these remarks it will be rightly judged that I do not think that "poor 66"—the naval department of the exhibition—quite occupied the position which, as the very foundation of commercial enterprise and maritime power it had some right to claim.

The class was very much scattered over the ground, and with the exception of England, no country displayed anything like an exhaustive show of its maritime progress.

I am unfortunately unable to speak from personal observation of the complete French display, as their naval department was unfinished when I left Paris in the middle of May, and I think that omitting France and England, the show was meagre.

The French display inside the building was, as far as it went, very good.

There was one large case containing very admirable models of existing iron-clads, the "Magenta," "Gloire," and those with which we became familiar in 1865, when their fleet visited our shores.

England, as it was her place to do, exhibited a wonderfully complete and well-arranged epitome of her progress and position in the naval world. "The Admiralty shed," as it was called, formed, even to the

landsman's eye, one of the most complete and attractive departments in the whole exhibition.

The Russian section was not so well represented as might have been supposed from her great enterprise and increasing maritime strength, but there appear to have been indications of the tendency to be in the van in the race of progress, which seems to be a very marked characteristic of that great power at the present day. Thus, while the main part of the displays of England and France were historical records of past triumphs, Russia gave us a few ships, embodying the most advanced opinions in respect of naval warfare.

Austria, Prussia, and America were very slightly represented, Italy would also have been in the same category, were it not that she made a very creditable and rather remarkable display of ironwork for shipping.

In one particular, France and England were represented, as probably no nations had ever essayed to exhibit themselves before. I refer to lighthouses, and the means of lighting and marking coast lines. Nothing could exceed the beauty, variety, and perfection of the apparatus displayed by both countries in a department of maritime science second to none in importance.

In the matter of ship-building, vessels of war naturally hold the first place in an exhibition; and just now when the whole question of their build, material, defensive and offensive armament, is familiar to the general public, and hotly debated in the professional circles of all nations, we may expect great varieties of model, and many lines of argument visibly carried out. Accordingly, from the huge two and three decker, through the iron-clad broadside frigate, turret ship, monitor, and ram: down to the sinkable torpedo vessel; we have a chain of illustrations, more or less complete, of the vast field now ranged over by the modern idea of a ship of war.

The great achievement—I think the greatest achievement I have ever seen in model illustration, was found in the English Department, in the beautiful ideal navy of the future displayed by Admiral Halsted and Mr. Napier. This group of model ships of war united a completeness of detail marvellous to see, and a care and finish of workmanship not exceeded in any part of the Exhibition. Admiral Halsted will, I hope, place in our journal some enduring record of his work, to describe which would require at least a separate paper.

The battle of "the turret versus the broadside," was illustrated in the English Department by a variety of models, some of ideal ships, but most of them by models of ships either actually afloat, or building. Russia exhibited models of the broadside iron-clad, the large class turret ship, and the "Monitor." Austria hinted her ideas of what is to come, by exhibiting a model of the now celebrated "Ferdinand Max," but showed nothing of her notions of a turret ship. America, from whom we might have expected the newest and most startling developments of modern ideas, was totally unrepresented. France showed us nothing in the way of turret ships, from which we could draw any conclusions as to her views.

As regards the question itself, the illustrations in the Paris Exhibition

neither advanced it, nor drew it back from the position it has for so many years held, namely, one of great uncertainty and wide difference of opinion. Nor do I expect that this generation will see a definite settlement, unless some nation will undertake to acknowledge and face the utterly antagonistic ideas prevailing, and will consent thereupon to very humbly begin from the beginning: so that, by a series of inductive experiments, the questions of dispositions of weight, free-board, rolling, and speed, shall be established upon true principles, and not left matters of speculative argument, about which the widest—I was almost saying the wildest—opinions are freely bandied about, and what is worst, acted on.

But what nation will incur the expense, or where are the men to be found who will commence and bring to an issue within reasonable time, a series of experiments so delicate and costly? Not England, we may be pretty sure, for if there be one thing that England hates more than another, it is a definite view; and it strikes no body of Englishmen as anything but natural and proper that after the turret system has been some ten years before us, we should have its great advocate claiming that less tonnage is required for a turret than a broadside-ship; and, on the other hand, Mr. Merrifield announcing publicly that one of the chief defects of the turret system is the enormous displacement it requires.

This, the starting point of the whole question, is in the position indicated by those two expressions of views, and I saw nothing in the Paris Exhibition which led me to hope that any nation was making systematic attempts to ascertain, before committing themselves, whether Captain Coles or Mr. Merrifield was right.

Then again there is that much-vexed question of low and high freeboard, which received its best illustration, on one side, in the Russian Monitor "Latnick," and, on the other side, in the models of the "Monarch," "Marengo," and our broadside frigates. But when one passed from model to model with the idea of arriving at some definite conclusions on the great naval topic of the day, one felt that so far from assisting in that process, the general display was bewildering and hopeless. Those who believed in high freeboard showed models in which it was provided; and those who took the other side—and they were in a decided minority—simply showed models in which their idea was developed. But what advantage was all this to any inquirer who wanted to see how things were likely to go? We knew before that opinions differed on all points of the question, and hardly wanted the Paris Exhibition to assure us of the fact. To my own mind, nothing in the Exhibition conveyed less satisfactory ideas than the helpless and unsystematic way in which all nations were attacking the question. There are certain things required to be separately experimented on, and separately ascertained, before we can satisfactorily spend a penny, and yet every nation is going on spending immense sums on new classes of ships, without any attempt to find out beforehand whether the expenditure will be successful.

I notice, for instance, that Captain Coles is quite sure that a "low freeboard" and a steady platform were convertible terms. Admiral

Elliot, in this Institution, laid all rolling at the door of disposition of weights—the engines and boilers. Others as distinctly lay down the law that the form of the bottom is the thing to be looked after. Others assert most positively that high freeboard is a preventive of rolling, as it raises the position of the centre of gravity.

Then comes one of those complicated propositions out of which mortal man never yet found a way. Thus: high freeboard is necessary for a broadside ship to keep the guns out of the water. This necessitates large plated surfaces, which, again, mean large displacements, large tonnage, and powerful engines. Then comes the other side, which says you cannot work your guns on the broadside because you must have high freeboard, and high freeboard will make you roll; therefore, you must work them in turrets. Next comes a third party to the argument, who says, "If low freeboard is good for the turret-"ships, it must be equally good for the broadside. What will happen "if you get rid of this mass of weight which is not water borne, and "make a broadside-ship which has a low freeboard?"

Lastly, there comes a weary enquirer, similar to myself, seeking for something like a fact on which to hang his opinions, who says, "would it not be well before we proceed to argue the point, to get some data on which to argue?"

Would it be very impossible, for instance, to construct two sections of vessels exactly alike, on a small scale, to vary the weights, height of free-board, and all points now in dispute, and ascertain what their *real* relations are to sea-worthy qualities?

How can the question ever be settled so long as we trust to experiment with ships on full scale, the sea-going qualities of which involve as their basis, at least, three factors whose values are unknown, namely, height of free-board, disposition of weight, and form of body.

There was in the whole Exhibition only one sign of any such attempt, this was the instrument of Admiral Paris, for measuring the rolling. The instrument consisted of a strip of paper, travelling at an uniform speed above and lightly resting on, a marker which traced the rolling and pitching in curves on the surface. The marker was the axis of a revolving disc, which being set in rapid motion, maintained its parallelism in the well-known principle of the gyroscope, and consequently gave a perfectly accurate tracing of the actual motion of the vessel on the travelling paper.

But this was an attempt at the attainment of definite ideas, which, as I before remarked, as Englishmen, we are bound to repudiate with the scorn such attempts deserve.

As regards the actual construction of ships, the series of drawings exhibited by the Committee of Lloyd's, illustrative of the "composite" system of ship-building, was well worth examination. This has been correctly described as a system where iron is used for the ships, and wood merely as a planking to keep out the water. And one could not help feeling on examining these drawings that there was a great deal of sound sense in the principle enunciated; iron, for the tensile strength so much required in ships of present enormous tonnage, and wood to resist abrasions and distribute pressure.

As regards armour-plating, I think a noticeable feature in the systems of England and France might be observed in the comparative smallness of French plates, and the much greater number of bolts employed in each plate. It was difficult to say from a general survey of the models, whether the tendency was towards complete or partial plating. I incline to the belief myself that partial plating, which was generally characteristic of the models, is an accident of the time, and that as knowledge of the subject is further developed, means will be found for giving complete plating; it may be of less thickness than at present, but of improved resisting power. I could, however, trace no sign of this in the Exhibition.

The English Government displayed very beautiful models of the structure of some of the newest iron-clads, internal fittings, and ventilation; this was wanting in the display of all other nations, but were it not so, it would be impossible, in the limit of time allowed for this paper, to do more than glance at the subject. The advance made by us in structure is the adoption of the double bottom. A ship like the "Warrior," if she once touched the ground would become a wreck almost to a certainty, for she has but a single thickness of iron on the bilge, to bear the weight of her enormous mass. While in the "Bellerophon," rocks may pass through her outer bottom while leaving the inner skin, or the actual ship, intact. But in my opinion, no war ship is perfect which has not her bottom sheathed with 6-inch plank. The first of our iron-clads which gets on shore, will hardly, unless the bottom be soft, come off again; and it appears to me that we run a most extraordinary risk in trusting ships of such costliness to the chances of a soft bottom.

We seem to have gone to the extreme in the matter of the length and tonnage of ships, and the tendency appears to be to bring back the length and tonnage to more moderate limits. I say this, notwithstanding the appearance of models, such as Admiral Halsted's ideal first-rate of 10,000 tons, of the "Minotaur" and "Northumberland," and of the Spanish "Numancia" of 7,000 tons burthen. But the newest patterns of ships show a desire to put a limit on length and tonnage. Seeing that in the relations of beam to length, the models show us an advance of from 1 to 4 in the "Duke of Wellington," to 1 to nearly 8 in the "Minotaur," it will be apparent that the extreme lengths cannot progress in like ratio for the future.

Fine entrances, and fine runs, are the noticeable features of all the newer ships. The abolition of the cutwater, and substitution of the upright, or tumbling-home stem, seems all but finally decided on, although the amount of tumbling home is by no means settled. There is evidently a double idea at work about the bows of modern ships: first the lightening forward, which is obtained by withdrawing the weight of an overhanging superstructure from its usual place; and next, a more or less decided contemplation of the use of the ram as a weapon. I only saw the model of one ship in which a full dependence was placed on this weapon; this was in the French department, and, if I rightly remember, was a model of the "Taureau." She is a ship of 2,400 tons, 196 feet long, and 47 feet beam, and is not armed for broad-

side fighting at all. She has a turret well forward, mounting, I think, two guns, which fire in line with the keel, and the whole of her bow is plated in, so as to resist any shot fired end-on to her. Her stem is fitted entirely for ramming, and she must needs give any one who believes in that mode of fighting, a very strong notion of her power.

Generally speaking, round, or pointed sterns are superseding the old square or elliptic ones; and the quarters are made purposely heavy, in order to protect the rudder and screw.

The general result of these changes is towards what a nautical eye, educated to believe in the beauty of graceful curves, must be characterised as the extreme of ugliness; but no doubt we shall learn to see and set up a new standard of beauty to meet the change of circumstance. For the idea of beauty in a ship is as the idea of beauty in a woman; and both break through and idealise the fantastic dress in which fashion or necessity clothes them. As a rule the eye rebels against a violent change in either the form of a ship, or of a woman's dress, but as it only takes a season to educate us up to the proper stage of admiration for the latter, I see no reason to doubt the same result will take place with the former.

Of course, in regard to the armaments of ships, the Paris Exhibition did not offer any illustration of a tendency other than an increase in the size of guns and a diminution of their number. As I have before remarked, and cannot too often repeat, I believe we are not laying sufficiently to heart this extraordinary reduction in the number of guns carried by ships; or, to put it better, in the number of shots capable of being fired by ships in any given time.

To come down from 121 guns in the "Victoria," in 1859, to six guns in the "Captain," of 1867—the latter being rather the larger vessel of the two, and to see the models of these two vessels opposite one another as specimens of naval architecture at the present day, is enough to show us that we are only on the borders of the question of attack and defence of ships, and that it is most improbable matters will either remain as they are, or continue to develop in their present direction.

As regards means of propulsion, the display at the Exhibition showed the gradual disappearance of the paddle as a propeller, either for the ordinary commercial requirements, or for war vessels of any size. But, on the other hand, we see that for passenger traffic, and for all classes of vessels where great speed, small carrying power, and light draught of water are the requirements, the paddle-wheel shows some signs of re-juvenescence. Greater boiler-pressure, and consequent increased number of revolutions, has reduced the size of engines and the diameter of paddle-wheels, so that in the models of yachts, mail steamers, and despatch vessels, the old huge towering paddle-box has disappeared, and a low, graceful curve in midships alone denotes the presence of the paddle. For grace of form, these newer paddle steamers are not put to the blush by any older specimens.

The single screw, two or four-bladed, is the mode of propulsion adopted in nine-tenths of the models exhibited. The English generally adopt for war purposes the two-bladed screw, means being given

for raising it out of the water when under sail. In the latest patterns, however, this idea of raising the screw—long ago abandoned by the French—seems disappearing. The enormous weight of the screws of first-class iron-clads has no doubt hastened this conclusion, but the interference offered by the screw-well with the steering arrangements, has had more to say to it. The conviction has also been gaining ground, that steaming power, and handiness under steam, should alone be attended to in the larger class of war vessels, and consequently trifling impediments to handiness or speed under sail have been more and more neglected. The French generally prefer the Mangin-screw, four-bladed, but with the second pair of blades behind the first, and in the same line, instead of being set at right angles to the diameter of the first pair, and in the same plane with them. The English use almost exclusively the Griffith-screw, or modifications thereof.

The twin-screw is clearly gaining in favour with all nations, although it was not shown at the Exhibition as adopted to vessels of large size. But there were a great many of the smaller class of vessels exhibited —as the "Smertch," in the Russian department, and several in the English department—using the twin-screw. · The advantages of the twin-screw for war vessels ought to be more distinctly understood than they are. Its advocates almost invariably set its manœuvring power, as first and most important on the list. I have no doubt whatever that this power must come last; for, as I have before remarked in this place, in the open sea, quickness in manœuvring is the most essential feature, while smallness of space occupied, is the chief desideratum in harbours and among fixed points. The minimum of space combined with the minimum of time, constitute true manœuvring power, and if a twin-screw ship, with proper rudder area, puts into action her peculiar power of backing one screw, while going ahead with the other, she does it at a sacrifice of time, although at a gain in space.

The true advantages of the twin-screw must be looked for in different directions. It gives efficient propulsion at light draught of water. It will enable the naval architect to shorten his ships, while increasing the beam, and it removes the chances of fatal damage to the propulsive power, twice as far as it was under the system of single screws.

It is as yet premature to say whether or no water propulsion, as illustrated in the model of the "Waterwitch," exhibited by the Admiralty, will run a race with twin screws. So far as I understand the theory, Ruthven's propeller should beat any kind of screw working in free water, for it should economise power in the matter of lateral slip. In every screw when revolving in free water, resistance is not entirely in a line with the keel, but is radial from the boss, so that the resistance at the extremities of the blades would, if resolved into its constituents, shew a considerable power exerted at right angles to the line of keel, and, therefore, useless for propulsive purposes. It is probably to this circumstance that we must attribute the otherwise remarkable fact of the almost imperceptible decrease of speed due to cutting off the corners of the old pattern screw. Now in the hydraulic propeller, as everything

is enclosed, and the water is not freed until it has performed its office, it would seem we should get economy of power. It is a subject of regret to me, as it is so often now in respect of other matters, that the hydraulic propeller was not treated somewhat more inductively, or that at any rate attempts were not made to sift the principle to the bottom on a small scale, where the expense of alterations would have been slight, before embarking in a trial so considerable as that involved in the fitting of the "Waterwitch," where, whether she succeeds or fails, the causes thereof may be so numerous as to defy selection. This is, however, another of those cases in which our constitutional objection to tentative experiment operates with injurious effect. We have so little faith in experiment, yet I believe the failure of our experiments may not be unjustly traced to this want of faith at the beginning. Speaking personally, I have immense faith in small experiments. In the minor subjects which have engaged my attention, it has been a matter of necessity for me to jump to no conclusion, but to lead up to it by very gentle steps; I cannot say, on comparing notes with others who have pursued a somewhat different course, that I have ever found this method either a slow or an expensive one.

Arguing from small things to great, I feel strongly impressed with the belief that small tentative experiments carried out entirely with a view to the establishment of principle, would, if more largely employed by the Government, be productive of most economical results.

As it is with the "Waterwitch," it is quite open to discussion whether, and to what extent, the principle is economical, but supposing that Government comes to a conclusion adverse to it, it will still be open to its advocates to assert that the question has not had a fair trial, and that the form of the ships, disposition of weights, &c., are the real defects, and not the propeller. But supposing it be decided that the propeller is an economical one as compared with those now in vogue, then its other advantages will be manifest. It has all the manœuvring powers of the twin screw, with a less demand for draught of water, and it has also the extraordinary and incalculable merit of being under the personal control of the officer in charge of the deck. The power being the same through all pitching and sending of the vessel, should give an advantage over the screw or paddle, whose power varies much in a heavy sea, while the immediate application of the full power of the engines in opposite directions should give a safety in action and in navigation, hardly to be exaggerated.

The "Waterwitch" was the only specimen of water propulsion exhibited.

Of minor, though not less novel modes of propelling vessels exhibited, one by a French inventor, and the other by Colonel Evelyn, in the English department, deserve notice. The principle is the same in both, but if success should ever attend its application in practice, probably Colonel Evelyn's plan would be found most perfect. The principle is that of the bird's wing. Great exposure of surface on one motion being given, and a withdrawal of that exposure when a reverse motion is communicated. In the French plan, a blade hinged

at its upper edge, so as to hang vertically, is attached to the end of a shaft, which is a continuation of the piston-rod, in a line with the keel. Instead, however, of being directly continuous, there is an arrangement on the principle of the lazy tongs, by which the length of stroke of the piston is multiplied considerably. The action of the machine is such that the out-stroke of the piston pushes the surface of the blade against the water and so propels the ship, while the back stroke allows the lower blade to come in edgeways. The back stroke is consequently lost, but, on the other hand, the power required for it is small.

In Colonel Evelyn's plan the hinged blade works vertically up and down a rod fixed abaft the stern-post. In the downward stroke the blade is at an angle of 45°, the outer edge being upwards, and in the up stroke it is again at 45°, but the inner edge is upwards. Thus nearly the whole of each stroke is utilized for propulsion. There is no rudder, but, instead of it, the propeller itself is turned from quarter to quarter by an ordinary steering-wheel, so that the whole power of the engines may be exerted at any angle with the line of keel. It is, to say the least of it, a singularly ingenious application of a known principle.

The objection to both these methods of propulsion is supposed to lie in the jar given to the whole structure by the blow of the blade against the water at each stroke, and thence communicated to the stop, or buttress, against which it rests. I am not quite prepared to say that this is a just idea; the float of a paddle-wheel is an analogous apparatus, and the Nasmyth hammer stands a probably heavier jar. And on the other hand, there is an evident simplicity and diminution of friction in transmitting the power direct from the piston without converting its travel into circular motion previously.

The enormous length in ships as displayed in the Exhibition, and their great speed, brought out as a correlative growth, great variety of steering apparatus. England displayed 15 varieties, France and Italy 3, Denmark and Sweden 1 each.

The varieties of rudders proper, were all in the English department, and were four in number—the ordinary rudder, the balanced rudder, Lumley's, and Hewitt's. On the ordinary rudder, I need make few remarks. Its demerits have always been twofold—first, the enormous increase of power required with every increase of helm angle, and as a consequence, the great strain brought upon the rudder head at such times. The first default has brought out a variety of appliances for acquiring this power, while the danger of the rudder head being wrung, has been met by the substitution of iron for wood, and by other methods of strengthening, which I need not particularise. The danger of wringing the rudder head was increased in our days by the introduction of rudders pivotted on the axis of the head, in lieu of those where the pintles were placed before it. It was a neater and more complete arrangement, but it required the application of something stronger than wood to make it perfect.

The balanced rudder is decidedly the greatest innovation of modern times in steering apparatuses, and yet, like most things which we are accustomed to call innovations, it is but a revival after all. The prin-

ciple of the balanced rudder was patented by Earl Stanhope before the close of last century, and lay in abeyance until taken up by Mr. Scott Russell for some of his ships. Its failure there, for reasons unknown to me, led most people to suppose that the principle was false, and so matters remained till 1861, when Admiral—then Captain, Key—to whose logical mind and unbiassed judgment much recent progress in marine *materiel* is due,—rightly concluded that the theory of the balanced rudder was true, and capable of application to practice. Acting on this conviction, he obtained leave from the Admiralty to carry out a complete series of experiments with a gun-boat, in order to establish or destroy the truth of his views. The experiments resulted in a complete triumph for the rudder, leading to its adoption in several of Her Majesty's ships, as well as in many foreign ones, and opening the door, I have no fear in asserting, for its ultimate adoption by all classes of ships.

Very great misconceptions with regard to the value of the balanced rudder, and the objects attained by it, exist; these, it cannot be otherwise than beneficial to remove. The balance rudder then, *per se*, has no more and no less power to turn a ship than any other rudder of the same length and breadth. It only proposes to abolish the two defects mentioned above, as belonging to the ordinary rudder. It so arranges the pressure of the water on its surface, that instead of being all abaft the axis on which it turns, enough shall be before it to compensate for that which is abaft. When this is secured, there is neither a wringing strain upon the rudder head, nor resistance against the tiller when hard over. We have heard from time to time remarks upon the admirable steering qualities of the "Bellerophon,"—a model of whose balanced rudder and fittings was exhibited,—under steam, coupled with defects attributed to her rudder, in her steering powers under sail. Unless it can be shown absolutely, that this defective steerage does not exist in the ship herself, it is unreasonable to attribute it to the rudder; for while there are *prima facie* reasons why the rudder should act well under steam, there are none why it should not act equally well under sail. In a properly balanced rudder, the helm may be put over to any angle, and righted again without expending more force than is necessary to overcome the friction in its bearings. This alone is quite sufficient to secure its place as the greatest improvement in the steering of ships brought to our notice in the Paris Exhibition. The rudder, however, is not without its defects. In order to allow for the arc described by the foreside of the rudder, its axis must be some distance from the stern-post, rendering it perhaps difficult to use ordinary pintles and gudgeons.

In the model of the "Bellerophon's" rudder exhibited by the Admiralty, it is only held by two bearings—one a collar round the rudder head, and the other a collar formed by a prolongation of the keel. The spindle of the rudder passes through it, and is secured on the under side by a nut. Many competent judges consider two bearings only, one at the waterline, and the other at the keel, an insufficient security both against a heavy sea, and also against taking the ground. In Admiral Halsted's ships the rudder has a further support of a

central pintle and gudgeon, and Mr. Scott Tucker exhibited a method of remedying this defect, which appears simple enough. He cuts out portions of the foreside of the rudder, sufficiently deep to allow it to pass freely above and below two gudgeons, prolonged from the sternpost to the pintles in a line with the axis of the rudder. Below these pintles the rudder is still more cut away, so as to allow the gudgeons to pass under these while shipping it. To effect this, the rudder must be placed at right angles to the keel, when the pintles fall into their places. When the rudder is in the position for use, the slots are not wide enough to allow of its unshipping.

Lumley's rudder comes next for consideration. The inventor exhibited five models, fitted on his first, second, and third systems; and the Admiralty exhibited one specimen of the first system, as fitted to Her Majesty's ship "Columbine," and very favourably viewed in reports from that ship. The principle of the Lumley rudder is, that a small portion of the afterpart shall, when the helm is put over, be always at a greater angle with the line of keel than the forepart. Whether the inventor has any special theory to show that a rudder of this form exerts, *per se*, greater turning powers than an ordinary one, I do not know; but if we avoid the complicated and unstable problems of hydro-dynamics, and take the force exerted by the water as a statical pressure, we shall find that an ordinary rudder of smaller area, at a slightly increased angle, will do more work. This may be easily understood by reflecting that when an ordinary rudder is at 45°, it is then exerting its maximum turning power. If you take a Lumley rudder of the same area, and place the forepart of it at 45°, that part is then doing as much turning work as the same portion of the ordinary rudder did; but the afterpart, being necessarily at a greater angle than 45°, is doing less turning work than the same portion of the ordinary rudder. Consequently the whole rudder is less effective. Did time permit, this might be shown to be true for every angle at which the rudder can be placed. If, however, it be disputed that the laws of ordinary statical pressure apply, it seems still by no means clear that the modifications which arise from considering water as the source of pressure, make against the theory. It seems probable that the angle between the two faces of the rudder would practically be filled up by dead water, and therefore any value it might possess would be lost, the water in motion passing off this dead water as it would off any solid surface. I am not about to deny the value of the Lumley rudder in a certain direction to be presently noted; but I think it of the utmost importance that the direction in which its value lies, should be clearly indicated. The experiments on which I found my view of the balanced rudder were conducted on the principle of rigid competition with an ordinary rudder, under exactly similar circumstances in the same vessel. It is the only way of trying the comparative merits of rudders, and I know of no such experiments with Mr. Lumley's.

The real advantage of this rudder appears to me that a portion of the strain is taken off the rudder head, and placed upon what may be called a false rudder head, the fixed pivot which by its eccentricity gives motion to the after rudder-piece. The probability is that helm enough

to produce a given result may be used by the helmsman with a less expenditure of force with the Lumley rudder than with the common one. This of itself would be quite sufficient to produce favourable reports where no comparisons could be made, but it seems probable that side by side with the balanced rudder which reduces the required force to a minimum in a simpler way, the Lumley rudder will not have a very extended reign.

In both these appliances it is sought by modifications of the rudder itself to overcome the difficulties of the question, but a much commoner plan, of which great varieties were displayed, is to leave the rudder untouched, and to apply mechanisms to the tiller, or yoke, in assistance of manual power. It is rather singular, by the way, that there was not a single specimen of any steering apparatus which proposed any other than manual labour as the prime mover.

Perhaps the most wonderful of all these appliances is the one to which we are most accustomed, namely, the ordinary steering wheel, which was exhibited by the Admiralty. In itself it is a simple shaft upon two supports, having three steering wheels upon it, with a barrel of large dimensions between two of them. The wonderful part of it is, the disregard of the elementary mechanical laws involved in the increased diameter of the barrel prepared for the wheel ropes; and the apparent attempt to ignore the relations between space and power. Perhaps no better instance could be given, in its mechanical aspect, of the tenacity with which the Navy clings to things which are once established, even when all reason for their continuance has disappeared.

In former days, when speed was small, ships were short, and the area of rudders was much less than at present, three or three and a-half turns of the wheel admitted of a sufficient economy of power to enable the helmsman to put the helm hard over without difficulty. The measure of the increase of power put into his hands by the use of a steering wheel was, first, the difference of diameters of wheel and barrel, or ultimately, the difference between the space passed through by any single spoke of the wheel, and that passed through by the extremity of the tiller. If the movement of any single spoke through a space of (say) 18 feet, placed the rudder at an angle of 10°, however you might vary the mechanism connecting the wheel and tiller, you could never assist the helmsman one jot, except in diminution of friction.

In the days of sailing vessels, the long tiller connected with the wheel by a simple "whip" purchase, admitted of the helm being put over by 3 or 3½ turns of the wheel. When screw vessels came in, their peculiar construction necessitated short "yokes" in place of the long tillers. As there was here considerable loss of power immediately developed, the purchase of the wheel ropes became a gun-tackle; and as the area of rudders became larger, and the speed greater, the purchase upon the yoke became a luff. The number of turns upon the wheel which sufficed to put the helm over when the purchase was a "gun-tackle," were plainly insufficient when the purchase was a "luff." Instead, however, of increasing the number of turns upon the wheel, and so preserving the purchase gained by the luff, the powers

of those days proceeded to destroy it, by enlarging the barrel of the wheel! the total result being evidently a loss of power over the rudder to the extent of the extra friction given by the increased number of parts in the tiller ropes. Many of Her Majesty's ships are still fitted in this way, and, as a consequence take eight or ten men to steer them, when an appeal to the elements of mechanics would reduce the number to two or three. The Holyhead boats, for instance, which are, I believe, 300 feet long, and, of course, require great facility in steering, have but one helmsman in the open sea, and four when going in and out of harbour. But the power of each man over the rudder is more than double what it is in our ships; for instead of exerting it through 3½ turns of the wheel, he exerts it through eight. I have been tempted to go more into detail in this matter in consequence of its great importance and direct application to many of our larger iron-clads now in commission. I read in the *Times*, for instance, that in order to put the "Minotaur's" helm up in 1 minute and 7 seconds, no less a number than 48 men were required: 30 at the relieving tackles, and 18 at the wheel. One feels that there is a waste of power somewhere, and the locality is at once indicated by the statement, that to give 40° of helm only 3½ turns of the wheel were used.

Where there is little besides friction to overcome, simpler mechanical appliances may be employed; and consequently the apparatus exhibited as fitted to the "Bellerophon's" rudder is a return to the old tiller and "whip." There are a great number of arrangements for working rudders by means of racks and pinions, and endless screws—some of them of great ingenuity and practical value; but they nearly all are applicable to the smaller class of vessels only, and I have dwelt too long already over the principles of steering to do more than mention the fact.

The attention which is now bestowed on the sanitary arrangements of ships was well illustrated in the section of the "Nymphe," exhibited by the Admiralty. Here we saw the application of scientific knowledge to actual circumstance, where the hollow iron masts and funnel were made accessory to the promotion of perpetual change in the air of the bilges, holds, and lower parts of the ship.

Respecting the masting, rigging, and fitting of ships aloft, the English Admiralty showed nothing. The French Admiralty exhibited most of their models fully rigged, and the stump top-masts, strong square yards, and light wire rigging, showed very plainly the increasing conviction that the motive power afforded by the wind has sunk from its ancient high estate, to be the mere assistant of steam. The models exhibited by Admiral Halsted were fully rigged, and conveyed to the mind a counter idea, that the mast and yard had not yet retired from active service. So also in the magnificent models exhibited by the Thames Iron Works there was considerable provision for using sails.

The abundance of ships' iron-work and wire-rope exhibited, showed how greatly iron is superseding wood and cordage, and how it is gaining daily new territories.

There was a considerable display of cables, capstans, and wind-

lasses, but not much in the way of novel anchors, of which the Martin anchor in the English department was the chief representative. This anchor consists of a shank, very short iron stock, and moveable crown and flukes. Instead, however, of one fluke only taking the ground, and the other remaining above it, as in the Porter anchor, both flukes enter, and so give increased holding power. Provided this anchor is not liable to drag for some time before "biting," as was the case with the old Porter, and providing it is not more difficult to handle at the bows than the present form, the Martin anchor would appear to have manifest advantages.

In the matter of marine engines, the Admiralty exhibited those of the "Sappho," beautifully compact, and excellent in plan, as all Penn's engines are; and also a very beautiful model of the engines of the "Minotaur."

The French put into their shed by the Seine a complete, full-sized engine, with boilers, screw-shaft, and screw complete.

Perhaps nothing in the application of steam machinery to Naval purposes, is more remarkable than the recent and sudden growth of steam launches. How far the movement is likely to go, it is difficult to determine: but so immensely useful in saving labour and time are these little vessels, that I fully expect to see the principle carried further and into smaller boats than at present. Two pairs of steam-launch engines were exhibited by England, and some by France. England employs the twin-screw and France the single screw and single cylinder. The latter are the simplest engines, and when the French and English Fleets were together, it was generally admitted that the French launches were the more powerful of the two, but much of that superiority may have been due to build, for the French launches were specially built for steamers, while ours were of the old form of boat.

With respect to the iron and brass work of France and England, so far as it relates to marine material, it struck me that there was a very marked superiority of workmanship in favour of England. There appeared to be a greater precision, and greater truth of surface in most of the English work, but then, I think, on the other hand, that we put a much greater finish into our work, and it may be possible that this extra finish deceives the eye. If it is so, or if the work is equal in both cases previous to finish, it might be economy on our part to content ourselves with rather less of mere ornament.

The difficulties connected with the use of iron ships, received illustration in the many plans for sheathing their bottoms. There were no signs that that question had as yet received its final solution. The cost of most methods prevents their wide application, and the ideas most in favour, lie in the direction of mere paint or varnish, washed off from time to time, but efficient while adhering to the bottom. In my opinion, in war ships the expense of wood sheathing covered with copper, and carried well above the water-line, would soon pay itself, and, as I before remarked, the wood sheathing seems desirable for purposes of safety.

The subject of boat-lowering appears to have attracted much atten-

tion lately; there were a great many plans exhibited, the chief and best of which were Kynaston's, exhibited by the Admiralty, and Clifford's, exhibited by the proprietor. Both of these are too well known to need explanation. Others were, in principle, similar to Kynaston's, but were defective in being more likely to "go off at half-cock," or inadvertently, before reaching the water; a very serious defect. There are certain requirements in a good boat-lowering apparatus which, until some one succeeds in uniting them all, will still leave room for inventors. The crew lowered in a boat at sea have quite enough to do to look after themselves until the boat reaches the water; the lowering should therefore be done inboard. But the lowering should be in the hands of one man, and it should be impossible to lower one end of the boat before the other. It should then be impossible to disengage the boat till it reaches the water, which is equivalent to saying the water should itself do the work. Lastly, the lowering apparatus should also be the hoisting one; that it is not so, is one of the chief defects of Clifford's apparatus.

The English Admiralty were much more liberal in showing internal fittings of ships than any other Government. Magazines, sashes, scuttles, capstans, hawse-pipes, cabins, hatchways, lightning-conductors, channels, and many other fittings, were fully illustrated and capitally arranged for inspection.

A binnacle-compass, lighted from the top, on a very excellent plan of Mr. Nunn's, with what is called a "course-indicator," attracted a good deal of attention from its novelty and neatness. The idea of the course-indicator is to prevent mistakes in the courses given, so that the helmsman may have as it were, a fixed index pointing out to him the course ordered.

While on the subject of compasses, I must not omit to mention one of the cleverest pieces of mechanism in the building—I mean Captain Arthur's recording compass. It is so arranged, that a pencil attached to the card traces the course of the ship on a sheet of paper placed under it; thus every little variation is inevitably recorded. The use of such an instrument generally, would doubtless prevent us from hearing so much of those extraordinary currents which sometimes land a ship on unexpected coasts.

In the matter of signals, I thought I was about to learn something very new and interesting when I read an entry in the French catalogue as follows:—"No. 21. Apparatus for night lights and signals: scientific work, by the late M. Sudre;" but my hopes were dashed to the ground when I ascertained the apparatus to be two bits of wood nailed in the form of a cross.

Signals were, in fact, evidently at a discount in the Exhibition—or rather perhaps Captain Bolton and I took up so much space over them that no one else felt disposed to face us. The excellent Commercial Code, however, put in an appearance with models for instructing merchant Officers in its use. It is not generally known that the Board of Trade now compels all merchant Officers to pass in signals before receiving their certificates. We may therefore hope that there will not be hereafter that absolute want of knowledge which prevents mer-

chant ships from ever answering our signals at sea when we want information.

In the matter of ship's lamps there were only two exhibitors worthy of note, Mr. Nunn in the English department, M. Chatel in the French. The French have evidently been doing much in improving and simplifying the lighting of their ships. While we have numbers of patterns, some bad and some good, and wander far and wide for manufacturers, the French appear to have but one form of lamp, adaptable to all purposes, have only one manufacturer, to whom they pay a good price and from whom they get a very good article. I believe the lighting of our ships might be economised by some such arrangement, and I am not prepared to say that our lower decks are as well lighted as they might be for the same money; for I doubt whether we apply right principles to the attainment of our object.

The French bow and mast-head lights are very much more elaborate than ours, they are also much more expensive; but, so far as I have compared them, the simpler and cheaper lights of Mr. Nunn, which are supplied to our ships and were exhibited in Paris, are the best of the two. In one respect, however, the French beat us in logical action. We have somewhere picked up the idea that a small vessel is less likely to come to grief from collision than a large one, and we consequently provide them with less powerful bow and mast-head lights. Were the decision to rest with me, I should be inclined to say, take care of the small vessels, and the big ones will take care of themselves. If any difference is to be made let the smallest vessel have the largest lights. The French use nothing but brass and copper for the metal work of their lamps, and I believe they consult economy in so doing, for I was recently shewn a set of copper lamps which had been ten years in use in one of Messrs. Wigram's ships, and they were without a flaw, whilst I know that our cheaper tin lamps soon wear out from corrosion.

A novel application of air to engine-room telegraphs was Mr. Gisborn's pneumatic telegraph. It appeared to work admirably, and as the air was all enclosed, seemed quite secure from getting out of order.

The display of buoys, beacons, and light-house arrangement by France and England were certainly finer than anything which has appeared before; and in the park, the great iron light-house over the lake, and the Trinity House scaffolding for the electric light—two structures between which appeared an undying rivalry—will always remain in the minds of visitors as very remarkable features of the display. It was a satisfaction to me to see the electric light at length beginning to take its place as the proper source of light for light-houses, and I do not doubt that, provided no other cheaper light of equal power comes forward, the electric light will gradually supersede all present First-order lights. The occasional bellowing of the enormous fog horn in the park, warned one that the time is probably coming when a ship reaching the English Channel in a fog will go from sound to sound as she now goes from light to light, and so find her way on in safety in spite of thick weather.

The difficulty in compiling a paper like this, is to know what

to touch on and what to pass by. I have endeavoured to take something in the nature of a general survey of the Naval Department, without going too closely into any particulars. Properly speaking such a paper should be written on the spot, for only under such circumstances can it be made really interesting or valuable.

Taking the naval display as a whole, I must acknowledge to great disappointment. First at the paucity of display—except by France and England—but more from the scattered state in which Class 66 found itself. It was two or three days' labour to inspect any one branch of the class, owing to the distances necessary to be traversed, and for the same reasons, any comparison between the work of the different countries was extremely difficult.

But the English naval display, taken by itself, was as unique and perfect a thing as I ever expect to see. Europe generally owes to our Admiralty a debt of gratitude for the frankness with which we opened our stores of experience and naval knowledge to their inspection. But I think Europe will owe us another debt for a different reason. The "Admiralty Shed" was a harbinger of peace amongst maritime powers, for no Frenchman, Prussian, American, Russian, or Italian, could pass from their own displays to that of the English without some such reflection as this: "What will the power who displays such energy and resource in times of peace in our favour, be likely to do against us in time of war?"

Evening Meeting.

Monday, March 2nd, 1868.

MAJOR-GENERAL THE HON. JAMES LINDSAY, Vice-President, in the Chair.

NAMES OF MEMBERS who joined the Institution between the 3rd February and 2nd March, 1868.

LIFE.

Owen, John F., Lieut. R.A. 9*l.*
Ollivant, E. A., Lieut. R.A. 9*l.*
Jago, John, Major 74th Highrs. 9*l.*

ANNUAL.

Tyrrell, Avery, Capt. 5th W. York. Mil. 1*l.*
Grant, Wilmot, Lieut. Rifle Brigade. 1*l.*
Webb, F. E., Lieut. 28th Regt. 1*l.*
Campbell, W. S., Ensign Rifle Brigde. 1*l.*
Morrieson, J., Lt.-Col. ret. Indian Army. 1*l.*
Darley, W. S., Lieut. 5th Fusiliers.
Roberts, Wm., Lt.-Col. 5th Fusiliers. 1*l.*
Tippetts, A. M., Surgeon 5th Fusiliers.
Ormond, W. C., Lieut. 5th Fusiliers.
Wilson, Richard, Lieut. 3rd W. I. Regt.

FIELD ARTILLERY ON THE CONNECTED SYSTEM.

By Major W. H. Ross, R.A.

In pace, ut sapiens aptarit idonea bello.—Hor. Sat. II., 2.

A TAUNT applied to inventors has now become almost proverbial, namely, that they are as sanguine of their inventions as poets are said by Horace to be irritable. How indeed could it be otherwise? If inventors had not always been sanguine enough to combat the depressions and checks incident to invention, there would have been no inventions at all; and in this view the word "invention" becomes synonymous with the phrase "arts and sciences."

Now, all inventions may, or should be, divided into three distinct phases: 1st, the original idea; 2nd, the practical development of that idea; and, 3rd, the improvement of that development,—which last may evidently be carried through a succession of gradations until what may be taken as practical perfection is reached.

I have ventured to preface my paper on field artillery with these remarks, having reference to a seemingly distinct subject—invention—because I wish you clearly to understand, and to give me the benefit of the result of that understanding, that what I have to ask your kind attention to this evening, is an invention in only the first or second of these phases, and, therefore, as completeness is neither pretended nor to be expected in this stage, so critical depreciation should be limited.

It seems indeed to be an impulse of humanity as universal as sanguineness in inventors themselves, to attack, or what is commonly called "run down," an invention which is presented before our minds by another, and these two antithetical impulses are doubtless placed by nature herself in the human understanding, the one to, as it were, *compel* the inventing or originating mind to pursue and carry through all difficulties its conception, which has, in many cases, proved of inestimable utility to mankind; the other to criticise and dissect the subject presented with surgical *sang froid* and minuteness—an impulse which, on the other hand, has doubtless prevented or limited a waste of money on many occasions by the rejection of crude or impracticable inventions.

It follows therefore, as a postulate to the acceptance of these two propositions, that depreciatory criticism should be indulged in an *inverse* ratio to the magnitude and alleged completeness of the invention proposed, while the praise which cannot be withheld from a successful invention is accorded in a *coincident* ratio.

Thus, if I were to come before you with a field-gun, whose application, I alleged, would render the assemblage of squares of infantry or masses of troops tactically impossible, pursuit ineffective, and the fire from guns on the old system almost harmless, and if I failed to establish these points by absolute proof in your minds, I should have as little reason as Horace's animal painter to "deprecate the "laughter of my friends;" but if I merely, as indeed I do, propose by the trial of a system different from that established, to inaugurate experiments which may lead to important results if successful, but to no great loss if failures, I should expect criticism certainly, but not derision; dissection, but not mutilation of my proposal.

Be so good as to remember also, that I do not by any means bring forward my proposal as the best system of field artillery in case it should be found convenient or necessary to alter the present mode of bringing field-guns into action. It is the best that I have been able to think of, certainly, or I would not have presumed to bring it under your notice to-night, but many Officers doubtless both would and could improve my suggestion, or perhaps suggest a fresh and better system altogether themselves.

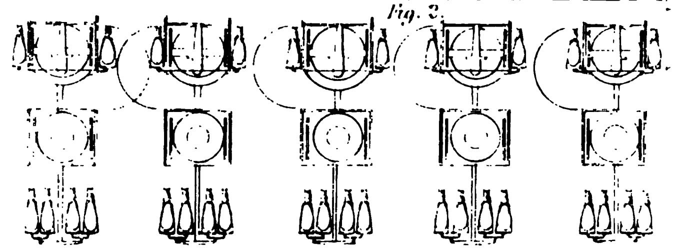
What I *do* assert with confidence, though some perhaps will call it

temerity, is that the present mode of dragging field-guns into action against an enemy, back-foremost, unloaded, and behind a cover of six of its own valuable horses three deep, is not only clumsy and slow, but unnecessarily extravagant in the exposure of men and horses to the enemy's fire. Again, as in the limber system, you cannot, or ought not, to bring your waggons under fire, the gunners, who for the most part sit upon them on ordinary occasions, must, of course, *walk*, and in that significant monosyllable old soldiers will at once see the paralysis of any rapid and decisive advance of artillery *en masse*, like that ordered by Napoleon at Wagram, when General Lauriston advanced with no less than a hundred guns *at a trot* from the reserve (a considerable distance) to attack the position of Adlerka. I don't know the means HE used, but where would the gunners of an English light field battery be after an advance of several hundred yards without waggons, at a trot? Certainly not with their guns; and when they eventually reached them, they would be too "blown" to work them for some time.

Now, let us look at a limbering gun. Here is a model, with four camels attached, instead of six horses, and the gun and limber, as you see, made on a very much larger scale than the camels; but it will do very well to illustrate what I have to say. You see how the cattle are placed, one before the other, and can easily imagine, if many of you have not actually seen, how a heavy *direct* fire of the enemy's artillery would strike the poor creatures, vulgarly speaking, "all of a heap." Now, if a General in battle gets into the awful scrape of having an enemy's battery opening fire on the flank of his artillery drawn up in line, he is deservedly censured. He could not well be in a more fearful position; but here is a *direct* fire converted into an enfilade one as regards artillery horses, simply from the way in which they are brought into action, and this *every* General *must* incur with his guns on the limber system. Look at these horses or camels now, and suppose yourselves to be an enemy against whom they are bringing guns into action. You see one covers the other. Do you think you could fail to hit them with your guns? and killing the leading horse, say with a round shot, you see how the one next to it, if not the one behind that again, would most likely be wounded and disabled by the same shot. To make this more clear, I will ask the gentleman in front of me to take hold of this string while I pull it until it resembles as nearly as possible a straight line, representing the trajectory of a shot. If now, I ask that gentleman to hold the string as far back as possible, you will see how even a shot fired at a considerable angle will traverse (or kill) two of my horses, and if you enlarge the range to the actual service one of 1,500 or 2,000 yards, you can easily imagine how this angle of mischievous fire might be much more enlarged, as the converging lines of a triangle tend more to parallelism the longer they are.

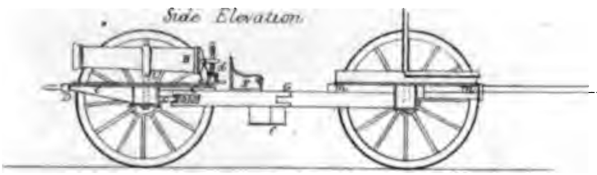
Now suppose me to be under a heavy fire from you, while I bring this gun into action. The first thing I have to do is to unhook the loop of the trail of my gun from the pintail upon the limber axletree bed. Now I am in action—and not at all slowly either—

Fig. 2.

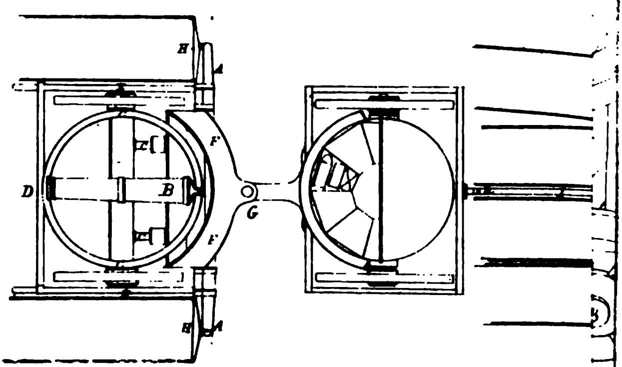


Smooth bore Battery of Horse Artillery on the Connected System with Revolving Ammunition Box &c.

Fig. 3.



Plan



W A Ross Captn. R. A. del.

fortunately *it is to my own rear.* If you were only HERE I pound you to pieces, but *my own troops are here*, I cannot, re, I fire in *that* direction. The second operation I have to per- der your fire is to bring round my limber and team to the rear. r (the enemy) are by no means blind; you have been waiting very operation (which, by the way, was represented by one of fied targets at Hythe). and now, as I expose the whole flanks of horses to you, you open upon them a deadly fire.* In the mean- e trail of the gun is brought smartly round, while one of the s is running after the limber to get a cartridge and shot out of e horses, if they have survived, are then brought up in their old ms position of three deep, some ten or eleven yards in rear of ; but you will see by this diagram (Plate IV) that the very same hots which would be liable to carry off three horses at once in sition of drawing the gun three deep, also form—not exactly a , that would pass scatheless—but a minute chord to the arc of le formed by them in wheeling to the rear, in other words, it gain pass througe two or three of them !

to these serious defects those of advancing against an enemy's k foremost and unloaded, and you must allow the limber system ing artillery into action to be bad at the best.

hese military defects, although of course the most important, eem to be by no means the only ones of the limber system of , the mechanical drawbacks being, if it was not a case of life th, of almost equal importance.

I not presume to give my own opinions or surmises on this , but quote those of no less an authority than the late Sir runel. After stating that "however powerful may be the of a limb, they must not be kept constantly on the stretch," t, therefore the "resistance" of the draught must be such low the animal to rest occasionally, Sir Isambard continues "Neither must it be a *yielding* resistance, as in that case al could not make any great exertion, for if he applied too ower, he would be liable to fall forward. . . . If a horse be drag a *rope* passing over a pulley, and descending into a well ertain weight, say of 200lbs., attached to it, it is obvious that l not make an effort greater than 200lbs. without instantly con- y increasing his velocity, *which would be a waste of power*, nor for an instant relax his efforts or fall below that mark, for he hen be unable even to resist the pull, and would be overcome by ght. Such an extreme case as this, of course, is not likely to ften in practice, but *the disadvantage of the principle is obvious.* dvantage of this kind of resistance is well known to carmen, of course, without consideration of the reason. A horse is pull better when *he is close to his work*, that is to say, when he hed at once to the body to be moved, because every exertion he

* ber 44 of the Journal of this Institution contains an illustration (Plate pended to Captain Majendie's paper on "Military Breech-loading Small hich shows this very well, if we imagine the dots to represent cannon shot rifle bullets.—W. H. R.

makes is then communicated at once to the mass, but the leader of a team, unless he keeps the traces constantly on the stretch, may frequently waste a powerful effort without producing much effect upon the carriage. Another inconvenience resulting from harnessing horses in a team, or *one before the other*, is, that the leader, by tightening the traces, is constantly relieving the strain from the body horse, and reciprocally, the body horse from the leader, so that these horses labour under all the disadvantages of a long, elastic, and constantly yielding connexion with the load, which is not only fatiguing to them, but, in cases where the resistance is variable, prevents the full and united effect of their exertions being properly communicated to the carriage, for, if a slight obstacle, as a rut or stone in a road, checks the progress of the vehicle, the shaft-horse can immediately throw his whole weight into the collar, and the united effect of his strength and impetus is conveyed unimpared to the vehicle, and forces it over the obstacle, but if any elasticity is interposed between the power and the resistance, as in the case of the traces of the leader of a team, the whole or the greater part of the effect of impetus is lost, and that force which, if concentrated in one effort, would effect the object, being lengthened into a continued and comparatively feeble pull is insufficient. If we wish to destroy the impetus of a body moving with violence, we receive it with a yielding resistance. The action of catching a cricket-ball exemplifies this perfectly, and, therefore, if the full effect of momentum is wanted, *all elasticity in the direction of the movement should be avoided.*"

I do not feel inclined to apologize for the length of this quotation, when I think of the admirably concise language in which it is expressed, and that the facts it so forcibly and incontrovertibly demonstrates, are so powerfully in support of my proposed system of draught for field artillery.

Let us then here summarise the defects of the limber system of draught, not forgetting that of requiring such an enormous extent of ground to enable even one battery to come into action, as you will readily perceive from this diagram (Plate IV, Fig. 1), which is according to scale. You see that every gun requires a space of nearly twenty yards to enable it to fire at all! Putting then the military defects first, we have—

1st. Advancing back foremost and unloaded.

2nd. Covered by two rows of your own horses, three deep.

3rd. Exposing the whole sides of these horses again to the enemy's fire in unlimbering.

4th. Exposing them three deep *again*, while coming round to the rear.

5th. When in a position to move, not in a position to fight, and *vice versâ.*

6th. Each gun requiring the enormous space of 19 yards to enable it to fight.

7th. Inability to bring your gunners up with the gun at a trot, without also bringing your waggons under fire.

8th. By leading the recoil down to the earth at a sharp angle (the

trail), you require the carriage to be disproportionately solid, and therefore heavy, to resist such terrible shocks.

With regard to the mechanical defects of the draught, you have heard Sir Isambard Brunel's evidence.

Now, a few days ago, I put the question to a very intelligent member of the "advanced class" of artillery officers now about to pass at Woolwich: "I wonder who could have invented the system of dragging guns into action behind a limber?" and he, I thought, gave a very sensible reply—that it was probably merely the application to guns of the mode of draught used with heavy carts or carriages.

Having thus fairly stated what I consider the defects of the limber system of bringing guns into action, I have now to offer for your consideration what I venture to suggest as a remedy; but in doing so, I must again beg of you to remember that it is not by any means brought forward as a perfect system, or one without many and perhaps serious defects. It is for you to balance the two together and to decide—

1st. Whether the defects of the limber system are greater or less than those of the one I propose.

2nd. Whether the defects of my system—which will doubtless be presently disclosed as fully as I have done those of the limber system—outweigh those of the latter so far as to render it unworthy of experiments on a large scale.

This is a model illustrating my proposed system, it was made by an Indian native carpenter and a blacksmith under my superintendence, in 1863. I invite your inspection of it, but at the same time, I must caution you that it is not intended as an *exact* model of what a nine-pounder smooth-bore would be if mounted on such a carriage, but the principle is faithfully shown. I must therefore ask any gentleman who discovers *mechanical* defects—as, for instance, the probable weakness of the pin or pivot upon which the gun revolves between the wheels, and again, the effect of this in weakening the axletree and axletree bed, which could obviously be rectified in many ways, as by employing a breech-loader—I say, I must ask such gentlemen to remember that no pretension to *mechanical* completeness is made, and that they will find it more profitable to examine the *system* offered, than the mode of its execution in a model. I have been under the impression, since my proposal was brought before the notice of the Bengal Artillery Select Committee, in 1857, until a few weeks ago, that my idea of artillery draught was thoroughly original; but, very lately, in reading up the subject in Louis Napoleon's "Etudes sur le passé et l'Avenir de l'Artillerie," begun by him in the prison of Ham, and continued after he became Emperor, I lighted upon the drawing of which I have here made a copy (see Fig. 4). I ask your indulgence for the roughness of my sketch, as I am no draughtsman, and having to enlarge it to twelve times the size of the original—a process quite new to me—I could not hope to be very successful. However, here is the sketch, and although rough, it is a tolerably faithful copy. You see that the gun with its trail evidently remains horizontal when fired; the gunner is seated on the

plane of the axis of the bore, and the horse and driver are behind. So far the idea coincides with mine, and the gentleman who devised it can certainly claim the precedence, as he appears to have made this wonderful sketch (according to the Emperor) about the year 1450; but I do not think an examination of my model will show any further coincidence between the two, and, to tell the truth, I was rather gratified than otherwise at the discovery, for it shows me I am not so absolutely alone in this field as I thought I was. Still more gratifying to me are the following remarks, passed by such an eminent artillerist as the French Emperor, upon this very drawing. He says, this figure "représente un canon en marche, la bouche tournée vers l'ennemi, toujours prèt à tirer. Un mantelet (I have left this unmentioned, as it does not bear upon the design) qui devait couvrir le canonnier, le cheval, et le conducteur, était destiné à faciliter le moyen d'approcher de l'ennemi avec moins de danger. Mais, pour faire feu avec un canon attelé, il est nécessaire de limiter la force de projection de manière à réduire extrêmement l'effet du recul, c'est-à-dire qu'il faut sacrifier la puissance de la bouche à feu; *c'est pour cela que l'Artillerie n'a jamais réalisé depuis cette époque, les avantages très-désirables qui étaient cherchés dans ce modèle.*"

I shall come to this subject of the recoil presently; and you will see from the account I shall give you of the actual experiments made on my principle with an Indian bronze 9-pounder, loaded with a round shot and the service charge of powder, and fired limbered up, that His Imperial Majesty is quite mistaken in his conclusion that "it is necessary to limit the projective force of a gun fired in this position, in order to reduce that of the recoil."

You all, I fancy, see the absurdity of this figure, independently of the defects in perspective, &c., for which I beg to observe, by the way, I am by no means responsible. Supposing this tolerably brawny gunner to be firmly seated, instead of being apparently posed—like gravestone illustrations of cherubims—upon nothing, we have the horse harnessed between a pair of shafts having little or no support, to a splinter-bar, which forms part of the gun-carriage itself, and receives by a rigid connection the whole force of the recoil! No mortal horse could ever have been found to stand such treatment, and we may therefore safely conclude this drawing merely to represent a *design*, and not an actual gun and carriage in practical use. This fact seems to have struck His Majesty, from the expression he uses, of "the very desirable advantages sought to be gained in this *model*."

While upon the history of the subject of limbers I may mention a remarkable fact I have never seen noticed elsewhere: that is, that in the old drawings of sieges, &c., as for instance, in those illustrative of the English translation of Machiavelli's "Art of War," of which a curious black letter copy is to be found in the Royal Artillery Institution Library, dated 1610—we find *garrison* guns looking through embrasures, &c., *unlimbered*, with the trail on the ground, and *field* guns fired horizontally upon four wheels. We have now *exactly* changed this arrangement.

I need not repeat here that my system—of which I have here a

racing of my drawing of 1859 (obligingly given me by Major Heyman, R.A., from the Select Committee Office), from which this model was made—is designed chiefly with the view of obviating the defects of the limber mode of draught above detailed. COUNT RUMFORD says, in his essay on "The Force of Fired Gunpowder," read before the Royal Society:—"The first step towards acquiring knowledge, is un- "doubtedly that which leads us to a discovery of the falsehood of "received opinions;" and, without making use of such a strong expression, I may, I hope, say without presumption, that when the first discovery was made, that the limber system of draught is radically wrong, I had advanced a considerable way towards rectifying it, for indeed, the chief difficulty I have to contend with is, not that the limber system is perfect, but that it is a "RECEIVED OPINION."

What I thought the first great defect of the limber system to be remedied, was the going back foremost against the enemy, and being obliged to break up the carriage, as it were, into two pieces before being able to open fire. In short, when ready to move, not being ready to fight, when ready to fight, not being ready to move.

Well, to have the muzzle of my gun pointed at the enemy during the advance, it was of course necessary to get the horses away from the front. Where were they to be put? I have placed four of them, as you see, in rear of the ammunition-box; the other two I place on each side of the gun in front. These I shall term, by way of distinction, the first "*propellers*," the second "*guiders*." These names will give you an idea of the work they perform, and if you will observe me, while I move the gun and carriage slowly to the front, this will become still more clear.

In order to allow the *direction* to be given to the right or left by the "guiders" or front horses, a joint must be placed (as indeed there is in all vehicles) in the front part of the carriage. I have placed it, as you see, in the thickest and strongest part of the trail, where it is at present locked by this pin attached to a chain to prevent its being lost. I remove this pin, and, as you see, the "guiders" can now move the front part of the carriage (sustaining the gun) freely to the right or left, as required, and so direct the passage of the piece to the front. These guiding horses are both mounted by riders, who obey the orders of the No. 1, conveniently seated somewhere on the carriage, to bring their "shoulders right" or "left," as necessary. They are, as you will observe, merely hooked to the side pieces of the carriage which protect them from the wheels, and are harnessed to swingle-trees strongly attached to the framework-arms, which enable them to revolve outwards to the extent of a semi-circle, or any *less* portion of the circumference. The "propellers," you will see, are placed so as to be protected or covered, not only by the gun itself and carriage, but by the ammunition-box (which is shot-proof). They indeed obviously enjoy an almost entire immunity from the enemy's *direct* fire. You observe that they also are harnessed, each horse to a swingle-tree, and each pair of swingle-trees to a strong pivot, which again is attached to a massive splinter-bar, which slides up and down the main pole. You will easily understand that by this means each pair of

horses can revolve outwards to the extent of a semi-circle on their own ground, in doing which, the inner horse will become the outer one, and *vice versâ*, but the "off" and "near" horses remain unchanged. It is of some importance to notice this, for the driver, as at present, will ride the "near" and *drive* the "off" horse, whether moving to the front or rear. The splinter-bar is locked to the pole by a pin passing through the iron collar, on which it slides up and down. The force exercised by the "propellers" in moving to the front, is thus carried along a *rigid* and *strong* line of stout wood and iron from the splinter-bar to the joint or point of direction of the carriage, where the draught is aided, and the direction maintained by the two "guiders." We all know how in natural philosophy the strength of the lever is increased by the distance of the force from the fulcrum, and in moving to the front, the pole and trail of this carriage are nothing more than a long lever, to which obstacles in front act as a fulcrum. This model is on the scale of about an inch to a foot; let us suppose then, this book, which is an inch and a-half thick, to represent a tabular stone or rising ground a foot and a-half high; this, if rising sharply, would be a very unpleasant obstacle to a team of horses harnessed in the present mode of draught, especially if moving at any pace. The wheelers would get the whole of the shock, the others pulling on an elastic resistance, but you see with how *very* slight an effort, pushing at the end of this long lever, I force the gun-wheels over this obstacle, of a foot and a half sharp obstruction. You observe how the gun-carriage turns partially in the shock, not meeting the obstacle fairly,—this is for want of the "guiders," who, of course, would spring upon the rising ground pretty nearly at the same time, and thus bring the gun-wheels *square* on to the obstacle. To show this, I will now lock the joint, by which means the lever is carried through the whole length of the carriage, and the propelling force applied to an obstacle at *right angles* to it, exactly as though the "guiders" were directing the gun in the same right line with the "propellers." You observe that the carriage surmounts the obstacle with still greater facility, and this facility is of course still further increased in proportion to the previous speed or momentum of the carriage.

We will now suppose a gun on the connected system having finished firing (or with any other motive) is to retire in action. This is effected,—instead of breaking the carriage into halves, one-half with the horses going left. the other half right about, gunners jumping down from their seats on the waggon, or running up breathless from where they have been left behind—simply by moving the *horses, not the gun*, which can continue its fire uninterruptedly. Let us begin an illustration with the "propellers"—though, of course in practice the thing would be done by *all* simultaneously—I wheel round, say the near pair on their pivot, thus—then the off pair: pulling out now the locking pin of the splinter bar, the whole back gently along the pole until the splinter bar is pushed back to the foot board of the ammunition box, the locking pin dropped into its new place, and these two pair of horses are ready to draw the gun to the rear. Similarly, the "guiders" are unhooked from their position along

le two side pieces, and, revolving outwards, are now facing the rear, ready to act in their new position merely as assistants in drawing the gun, harnessed on two outriggers. The gun and carriage is now ready to move to the rear, but the joint, or point of direction, must, of course, be changed. The front joint is locked by the pin before described, and the gun, *for the moment* unlimbered—for this gun *can* unlimber, if required. You observe, however, a peculiarity about this limber arrangement. There is, as you see, a double trail loop, and, of course a double pin tail on the limber axletree bed. By hooking up *both* loops, the joint is locked, by hooking one only, there is a joint, exactly in the same manner, and in the same place as the present carriages have it. Here you see, I have hooked one loop only, and the point of direction now rests with the propelling horses.

Another point to which I wish to call your attention here, is, that when my carriage is broken into halves or "unlimbered," horses (or motive power) *remain with each half.* This is an important advantage, for a gun carriage piecemeal, *i.e.*, two two-wheeled carriages, can thus be extricated much more effectually from heavy ground than one four-wheeled carriage could. If the Horse Artillery gun which stuck in the sand at Ramnuggur in the Punjaub campaign had possessed this power of locomotion, it would not have been lost.

The gun can now retire *in action* at any pace, in a position similar to what is called by sailors "a stern chase," or to the method known in battery drill as "retiring by the prolonge," which, as you are all aware, is simply a stout rope connecting the trail of the gun with the limber, so as to dispense with the operation of hooking up and unhooking every time it comes into action.

It is now time to show you how I propose loading and firing my gun in this position, and how the unavoidable shock of the recoil can be lessened, if not altogether obviated as regards inconvenience to men and horses.

The gun, you observe, is a muzzle-loader, although a breech-loader would answer the purpose better in every way, but at the time I first made my plan (1857), the breech-loading principle was inadmissible with the Select Committee, and it was a *sine quâ non* with inventions in guns, that they should be muzzle-loaders. I had therefore to allow this large space between the wheels to enable my gun to be loaded without the necessity of the gunners jumping down. It is loaded as you see *from* the rear, but *by* the muzzle; the gun being pulled round for the purpose by a lanyard attached to a ring in the muzzle mouldings, the vent being stopped by a plug of wood covered with chamois leather. You may easily imagine now, the gunner *kneeling* on the seat where he was sitting while the carriage was in motion (or in smooth ground, the gun could be loaded *while* the gun was in motion), and ramming down cartridge, &c., *over* the circular seat bar, the gun being elevated for that purpose, and to prevent danger in case of accident.

I have before stated, that I consider my ammunition box to be shot or shell proof, except in case of *vertical* fire, which could not well be received in a field of battle. I will now show you my grounds for this

out orders like the following:—"The line or brigade will retire 10 or 12 paces and halt, front." Now nothing can be easier than for infantry or cavalry to "halt front" on their own ground, but for a limbering battery, which is 34 yards deep, to do this, it not only requires to advance some 40 yards to the rear of the proposed alignement before coming about, but to keep the interval of a division (19 yards) to the right or left, in order to enable it to come up square. A connected battery on the other hand, could retire and "dress up" to any new alignement with the same facility as cavalry or infantry.

It now only remains for me to notice the RECOIL, on which account alone, according to the Emperor of the French, "artillery has never been able to realise the very desirable advantages sought," by advancing against the enemy, *face* instead of *back* foremost. I have before stated, that the shock of the recoil can be greatly lessened, if not altogether obviated by mechanical means on the connected system, where the axis of the piece is maintained in a plane practically nearly horizontal with the surface of the ground, and indeed, as the carriage is slightly depressed towards the rear, the gun will in fact require very considerable elevation to make its axis horizontal with the plane upon which the wheels travel, *i.e.*, the *direction* of the recoil. This will be more apparent if I lay the gun of this little model point blank, and then turn its side towards you. You see, it appears now to be slightly depressed, whereas in reality it is about point blank. If I now unlimber the gun, and drop the trail on the table, it is no longer level with the ground, but elevated, at a very considerable angle. To reduce this angle, I have to elevate the breech, or, in other words, weaken the resistance of the elevating screw. But as the centre of gravity of the gun and carriage in this position is obviously *below* the axis of the piece, in which direction of course the recoil, that is the force of the elastic gas of the fired gunpowder back from the bullet, is transmitted, the whole would obviously, if unchecked, have a tendency to revolve round its movable centre on being set in motion by the recoil. This centre is of course the axletree of the carriage connected with the gun by its trunnions, and, if it could be so balanced that the trail could be just supported and no more, the gun and carriage on being set in motion backwards, would begin a revolution upon this axis—thus. Now, what checks this tendency to rotate round the axletree? Why the *point of the trail touching the ground*, and if the shock were strong enough, and nothing gave way, this last, forced into the ground, would form the centre of rotation, and the gun and carriage tilt right over it—thus. This destructive effect on the carriage of course increases with the angle of elevation. Now the shock thus given to the carriage carried down to the very earth itself at a sharp angle by the trail, may be imagined, if not actually measured, by supposing a case in which the earth would offer no resistance whatever to the point of the trail, but allow it to slip backwards on a level plain with the full force of the recoil. Strange as it may seem, such a case actually occurs in the service of our artillery in Canada where guns are occasionally fired on "glare" (which I suppose means very smooth) ice. The recoil in such a case, according to General

these spaces between the guns have the advantage of allowing many shots to pass scatheless which would be received by a connected battery, upon which in fact the enemy's fire would be more concentrated. This, which seems at first a plausible objection, is easily demolished. In the first place, artillery on the limber system is always betrayed to the enemy *per se* when advancing, or not actually engaged, by this very open space which it requires. Looking through a telescope, you cannot possibly mistake a limbering battery for any other arm, and accordingly you proceed to demolish it during its advance, while a connected battery, especially if, as might very well be done, it had say half a troop of cavalry between each subdivision, could not be distinguished as artillery until it had commenced to open fire. *Secondly*, if *concentration of fire* be dreaded, there is nothing to prevent the enemy concentrating their whole fire on each gun isolated on the limber system, successively, until it was absolutely disabled. *Thirdly*, the connected battery can always, if required, open its intervals to *any* distance and have soldiers of other arms between, but the limbering one cannot *close* them to more than 19 yards *clear* interval, or thereabouts, without paralysing its power of coming rapidly into action. Again, a glance at this diagram will at once show that there are many natural and artificial objects on service—a mound, a farm-house, a few hay stacks—behind which such an easily handled compact mass as a connected battery could be effectually protected from the enemy's fire, while it would be difficult to find 114 yards of cover for a limbering battery.

Two-thirds of the horses of a connected battery, *i.e.*, twenty-four out of thirty-six, are, as you have seen, protected almost absolutely from the enemy's fire both in advancing and retiring, but what is the case with regard to the limbering horses? You see here, as I have before shown, how it is quite possible for the *direct* shots of the enemy not only to pass through *three* horses during the advance, or when drawn up three deep eleven yards in rear of the gun in action, but also while the limbers are wheeling to the rear in order to allow the guns to come into action.

When we turn from defensive to offensive considerations, I submit that the value of having guns on my system is still more marked. As a limbering battery occupies more than *three* times the space of a connected one, it follows that you could place three batteries for one, or eighteen guns for every six in the space allowed to field artillery at present; and when one considers that almost the chief value of artillery lies in a possible concentration of its fire in a general engagement, this fact is of very great importance.

Among minor advantages, I reckon the very great facility with which connected guns could be handled, compared with limbering ones. Any Officer who has commanded a brigade of the three arms on a field day, must have felt how awkward the guns are to work compared with the other branches. On the other hand, artillery Officers often with reason, complain that they receive orders applicable to infantry or cavalry, but very difficult if not impossible, for artillery to execute. As Captain of a horse field battery in India, brigaded with infantry and cavalry, I have myself been considerably puzzled how I was to carry

fectly level tramways of polished steel, would be more likely to give us results more available for practice?

A couple of experiments will show you what I mean. You see the gun which I have here detached, carries a couple of horizontal buffers, which, of course would be of a certain strength, and the pistons graduated. I now load the gun, and sprinkle with this brush a little flour over the pistons, which sticks to the oil with which they are covered. I now replace the gun, and mark the point of contact of the wheels with the surface of the ground. With the full-sized gun this would be done by having a scale graduated on both the tramways, besides which, the whole gun and carriage would of course be accurately *weighed*. I now fire the gun, which you see has moved backwards a very little, and examine the buffer pistons, the flour on which will of course have been pushed back to the extent they have been moved up into their cylinders. These will not show any mark, because as I said before, they are too strong for this model. If then, the extent the *wheels* have travelled may be taken to represent the *inertia* of the gun and carriage + the friction, the space cleared from flour of the buffer-pistons will show the actual momentum of the recoil.

I now unlimber the gun, and after preparing it in a similar manner, fire it again in the new position. It is obvious that by a number of experiments of this kind on a large scale, the actual recoil of guns under almost every condition of actual service can be ascertained. I have a memorandum here of 13 rounds fired with this model (I will not take up your time in reading it, as it is never safe to reason up from experiments with models or small arms to the probable effects of firing large guns), which shows however, a curious fact, that on a perfectly level polished mahogany table this little model loaded with only half a charge, recoiled as to the *wheels*, *forward* instead of *backward*, half an inch.

I will now conclude by reading from this paper a short account of some experiments conducted at Ferozepore in 1858, with a 9-pounder, carriage and limber (Indian pattern), lent to me by the late Lord Clyde for experimental purposes; my battery, however, having been ordered to Peshawur, I was not able to conduct the experiments myself, or even to be present at the time.

"My dear Ross,—I must tell you the result of some experiments made by Mr. Coates with the 9-pounder gun you borrowed from the magazine, which I witnessed a few days ago. The gun was lashed to its limber with rope, the loop being in contact with a block of lead fastened on the limber axle bed. The gun was loaded with round shot, and a service charge of powder. Mr. Coates fired the first round while sitting on the gun carriage seat, without any material inconvenience to himself—the recoil was 7 feet in a very smooth level plain. Several rounds were then fired by Mr. Coates while sitting astride of the beam, the wheels being sometimes blocked to prevent the gun moving, and sometimes allowed to recoil—the result was satisfactory. Two rounds were fired by Mr. Coates while the gun was in motion towards the rear, the result being equally satisfactory. In one instance, I and Serjeant Mann sat on the limber boxes while the gun was being fired, and we experienced no inconvenience. There is no doubt that if the recoil were resisted by buffers, as you propose, the gunners could, with perfect ease, sit upon the gun carriage and limber."

Mr. Coates says regarding this experiment :—

"From the first trial without a buffer, it is evident that buffers can be omitted, though no doubt the shock can be done away with entirely with them."

At the second experiment, Mr. Coates substituted for the sheet of lead on the limber axletree bed, of which I had never approved, although I remained long enough at Ferozepore to remark that he intended trying it,—an attempt at the execution of my original proposal, which was to place buffers or springs in such a position in the carriage, that they would not only serve to resist the shock of the recoil of the gun, and take it off the horses, but also cause the draught to be more easy to them by having a great part of the whole weight to be pushed as it were, divided from them by these springs. Mr. Coates, however, committed *two* faults in the execution of this design, which, with the badness of the materials used, which were old and worn out, caused, as is detailed, "the greater part of the gearing to give way" on the first shock. His first error was in using a spring of so many plates of steel, that, for the purpose of resisting the recoil of a gun, which, it will be remembered, is essentially a quick, powerful, and sudden stroke or blow,—his spring was in fact no spring at all, but a mass of almost solid iron, much less impressible than the sheet of lead he had formerly used. His second error was in placing his buffer behind, instead of before the limber axletree bed. Captain Lewis thus describes this second experiment to me:—

"I don't recollect exactly how the springs were fixed, and my drawing is not very clear. The buffer did not act, the springs were, I think, too stiff, and from the action of the recoil not being quite direct upon the spring, the axle bed was split to pieces; however, Coates managed to fire a few rounds while the gun *was being propelled to the front by about twelve European gunners, at a considerable pace;* they were of course brought up sharp, but none of them were thrown down."

Mr. Coates referring to this partial failure, says:—

"I did it up hastily, and the first fire some of my gearing gave way, and I suspended the trial and set to work doing it substantially, and next week hope to give you the details of the experiment with a buffer."

Neither Mr. Coates nor Captain Lewis state the number of plates of which this spring was composed, but they must have been very great, as Mr. Coates in a letter to me detailing the final experiment, soon after, says he even then used 20 plates to his buffer; this letter is dated 14th June, 1858, and says:—

"I have just had a fair experiment with the buffer; it was made of four buggy springs or twenty plates, but three springs would have done better. I had a number of Artillery Officers seated on the limber boxes, and myself on the gun axle seat; I had the whole driven to the front by men at the pace of a good trot, and fired repeatedly, and the shock was not so strong as to require you to hold anything, therefore this problem is solved most satisfactorily. I now propose to have a trial with horses as soon as I can get ready; in the meantime I am going on with my model of the gun and steering apparatus."

Captain Lewis says of this third experiment that—

"The result was so far satisfactory, that the shock to men sitting on the carriage and limber when the gun was discharged, was much less than it would have been without the buffer, but the gun recoiled almost as much as when first limbered up and without buffers; I think the recoil was from 5 to 7 feet on a very smooth level plain."

In 1865 Sir William Mansfield lent me another similar 9-pounder and carriage, but as he soon after removed me from the horse battery which I commanded, I was again unable to carry out any experiments on the large scale, and was, therefore, reluctantly compelled to return the gun into the arsenal at Allahabad.

I have omitted to mention that of course, if convenient, guns on the connected system could be drawn by horses on the line of march, or, where preferred, in the usual way, the peculiar arrangement I propose being reserved for the field of battle.

My chief aim has been to avoid anything like *complicated machinery*

to effect the purpose of guiding to the front, &c., which those who have been, as I was, at Chillianwalla, under a fire of 100 guns, firing round shot, we opposing them for half an hour, with only *one* battery of 10 heavy guns, well know to be *utterly inapplicable* to artillery on service.

At the eleventh hour, as I was leaving Woolwich this morning, I found the following paragraph in Count Rumford's essays :—

"The iron 18-pounder constructed at Munich was intended for covering troops retreating before an advancing enemy, and is so contrived that it can be fired without stopping, or while it is *in full march.* It has, indeed, often been fired, and very quick, too, while the horses which drew it were in full gallop. The carriage, which is upon four wheels, serves at the same time as our ammunition waggon, and also for carrying the men who serve the gun. These, however, are only three in number, and more are not wanted.

"I had contrived a gun on these principles which could be fired *advancing* as well as *retreating* in full march, but as I am not now writing a treatise on artillery, it would be improper for me to enlarge further on the subject,"—p. 216.

I have only now to thank you for the patient manner in which you have listened to me.

Table of Results of Experiments on Recoil with Model.

Round.	Charge.	Wheels, Movement of.	Buffer Movements.	Remarks.
No. 1 C.*	$\frac{1}{2}$	$1\frac{2}{8}$ inch	No mark	On table. *Forward.*
2 C.	Full	$\frac{1}{8}$ inch	Do.	Table.
3 U.	Do.	Not moved	Do.	On ground, trail embedded.
4 U.	Do.	Do.	Trace........	Do., right wheel and trail embedded.
5 U.	Do.	Do.	Do.	Do., right wheel and trail embedded.
6 U.	Do.	Do.	No Mark	Do., trail marks.
7 C.	Do.	Moved back about $\frac{1}{2}$ in. and then forward to old mark	Do.	On ground.
8 C.	Do.	*Forward* $\frac{2}{8}$ths	Trace........	Do., gun at an angle to right of about 30°.
9 C.	Do.	1 inch	Do.	On table.
10 C.	Do.	$\frac{1}{8}$ths inch	Do.	Do.
11 C.	Do.	$3\frac{1}{2}$ inch	$\frac{1}{16}$th inch	On ground, loaded with *a long wooden shot.*
12 C.	Do.	$2\frac{1}{2}$ inch	$\frac{1}{16}$th inch	Do. Do.
13 U.	Do.	Trail stopped	$\frac{1}{8}$th inch	Do. Do.

C—*Connected* : U—*Unlimbered.*

The CHAIRMAN: We are very much indebted to Major Ross for having brought this subject forward. I know perfectly well, from having worked a brigade, the extreme inconvenience which results from the great length, from front to rear, of the gun and its appurtenances, and from the gun always pointing to the rear, having to be brought round with a long train of horses to get it into action. The difficulty in the plan before us, appears to me to attach to the breadth of the gun-carriage with the side horses.

Major Ross: This is a muzzle-loader.

The CHAIRMAN: But still with a breech-loader you would have a horse on each side.

Major Ross. Yes, on each side; but you could reduce the width of the gun carriage.

The CHAIRMAN: It is not often you meet with roads wide enough for horses on either side of a gun carriage.

Major Ross: It requires four yards only; but you could always adopt the limber draught in marching.

The CHAIRMAN: If you wanted to bring your gun into action, could you alter that arrangement, and have your horses on each side?

Major Ross: Yes, certainly.

The CHAIRMAN: Then that does away with the difficulty that occurred to me. I was thinking of the breadth that the guns would occupy.

Major Ross: This model is too broad to show my plan properly: it is broader than there is any necessity for. The present guns are 5 feet, from tire to tire; and my carriage would only be 6 feet—1 foot more. It is the horses that would make the extra breadth, but they are not required on the side while on the march.

The CHAIRMAN: It is quite plain that if you can always carry your gun pointing to the front instead of to the rear, it would be an immense advantage.

Major Ross: An immense advantage in every way.

LECTURE.

Friday, March 13th, 1868.

Colonel the Right Hon. THE EARL OF LONGFORD, K.C.B., Under Secretary of State for War, in the Chair.

MODERN ARTILLERY AS EXHIBITED AT PARIS IN 1867.

By Lieutenant-Colonel C. H. Owen, R.A., Professor of Artillery, Royal Military Academy, Woolwich.

The subject upon which I have been requested by the Committee of this Institution to read a paper to-day is—"Modern Artillery as exhibited at Paris in 1867."

No doubt many of you visited Paris last summer, and I am sure that all who did so, must have been much struck by the evidences there shown of the progress made in the manufacture of military weapons since our last Exhibition in 1862. The question has often been raised, as to whether military arms and appliances, intended solely for the purposes of destruction, should be allowed space in an Exhibition devoted to the display of those things which have been contrived with a view to increase in every possible way the preservation, comfort, and material prosperity of mankind. I do not, however, propose to discuss this question, since it has been practically solved by the reception of munitions of war into these International Exhibitions, in which the gradual development of modern artillery can be traced to some extent.

In my report on the artillery exhibited at Paris last year, I took each country, and described the guns, carriages, and other *matériel* shown in the department allotted to it, the object being to give any one visiting the Exhibition, a tolerably accurate catalogue* of what was to be found, and where to look for any particular object. Such a plan would, however, be totally unsuited to the present occasion, involving as it would do a tedious amount of detail, with the greater

* The ordnance were not catalogued, except those in the British department and a few others dispersed at random among the different classes in the general catalogue.—C. H. O.

part of which you are doubtless familiar. I shall content myself with endeavouring to point out the present condition of the artillery armaments of the chief great Powers.

In order to simplify the subject, I shall divide it into the following branches:—

Ordnance.
Carriages.
Ammunition.

In speaking of ordnance, it will be unnecessary to give a detailed explanation of the different materials or methods of construction, or of the various systems of rifling and loading, as all these have been so frequently described and discussed within these walls. I myself had the honour of reading a paper here three years ago, in which I attempted to consider each of the above questions separately, and as it has been printed in our Journal, it would only be waste of time to repeat what can easily be obtained if required.

I shall, therefore, to-day merely draw your attention: 1st, to the particular materials and constructions; and 2ndly, to the systems of rifling and loading, adopted for the ordnance of different services.

The ordnance shown by our War Department were, with one exception, a 10-inch cast-iron mortar, all built up, the smaller natures of wrought-iron alone, but the three heaviest guns, of wrought-iron exterior, with a steel inner tube. They were built up on the Armstrong method of construction, except a muzzle-loading 64-pounder, in which the Fraser modifications have been carried out.

Mr. Fraser's plan of manufacture has very great advantages over the Armstrong method; for besides the reduced cost and saving of time, a very much stronger construction is obtained by the double or triple coiling and welding together several portions, so as to have but few pieces in a gun. The liability to separation of parts, a manifest defect in the original Armstrong construction, and which was lessened by the introduction of Mr. Anderson's hooks and recesses, is very much reduced, if not practically prevented in the Fraser guns.

There is every reason to believe, that we have now, by grafting the Fraser modifications on the Armstrong construction, and by the employment of steel for the inner tube, arrived at a very satisfactory stage in the manufacture of heavy ordnance, combining as it does great strength and endurance with moderate cost, and protection by the wrought-iron exterior from dangerous results, should fracture of the barrel occur.

The 12-inch or 600-pounder rifled gun was the most powerful piece exhibited that had been subjected to proof, and we must not forget that our first 600-pounder, of 13·3 inches calibre, made by Sir W. Armstrong several years ago, has fired more than 200 rounds, some with very large charges of 90 lbs.

Until lately 400 rounds were considered as the limit of endurance of our heavy built-up guns when fired with battering charges; with ordinary charges, which caused little or no *scoring*, a far greater number can be fired without injury to the piece, but the scoring or guttering commences, and rapidly increases with battering charges

(of powder like our own), unless the rush of gas over the shot is prevented. By plugging up the vent when the scoring had increased to a dangerous extent, and drilling a new vent, the gun being reversed, the limit of endurance can be nearly doubled. Recent experiment has, however, shown, that by placing a wad between the cartridge and base of the projectile, the scoring can be prevented, or at least very much lessened, even with battering charges, so that we may confidently expect that the heavy rifled guns we are now making, will prove as durable as the old smooth-bored ordnance. I could give you instances of 9-inch guns having stood 500 battering charges without sensible injury, and of 9- and 7-inch guns which have been fired over 1,000 rounds. Sometimes you will hear of service guns giving way, but on inquiry, it will be found that they were made several years ago when the manufacture was but imperfectly developed, and the materials not so good as those now used.

In the Annex devoted to private British exhibitors, three methods of construction were illustrated—Armstrong's, Whitworth's, and Palliser's. Two Armstrong built-up guns were sent from the Elswick Works, one a 9-inch, with a coiled iron inner barrel, and the other a 12-pounder, with a steel barrel. The Whitworth Company exhibited built-up steel guns, and some smaller pieces, which were solid forgings, with separate trunnion rings. In the built-up guns, the outer portions are pressed on by hydraulic pressure, instead of by shrinking, as in the service, or Armstrong guns. These Whitworth guns possess no doubt great strength and endurance, so much care being taken in the testing of each portion, and in the whole manufacture, but being made entirely of steel, they must necessarily be very expensive, and more dangerous in case of fracture, than those having wrought-iron exteriors. The largest of them is only a 7-inch gun throwing a projectile of 150 lbs. Major Palliser showed a 9-inch gun made of a coiled iron interior, with an outer jacket of iron cast over it, and which had been subjected to the test of 111 rounds with heavy charges and projectiles. You are all no doubt aware that he has for a long time advocated the utilisation of smooth-bored cast-iron guns for rifled ordnance, by boring them up and inserting a coiled wrought-iron barrel, and some of such converted pieces have stood severe tests. I think that Major Palliser will find his chief difficulty with large ordnance, in getting coiled barrels sufficiently sound to stand heavy charges. However, he is going to state his own case to you shortly, and I for one shall be very glad to hear his latest views and proposals with regard both to the conversion and manufacture of heavy guns.

Let us now consider how the French make their heavy ordnance. They, like the Americans, have adhered to cast iron, contenting themselves with improving the manufacture and strengthening the guns with exterior rings or bands. We in this country have little confidence in ordnance so made, if required for firing heavy projectiles with large charges, the results of our own experiments and the failure of the Parrot rifled guns at the siege of Charleston, and the bombardment of Fort Fisher in America, having proved their liability to burst in spite of the strengthening rings. The French heavy guns are hooped with

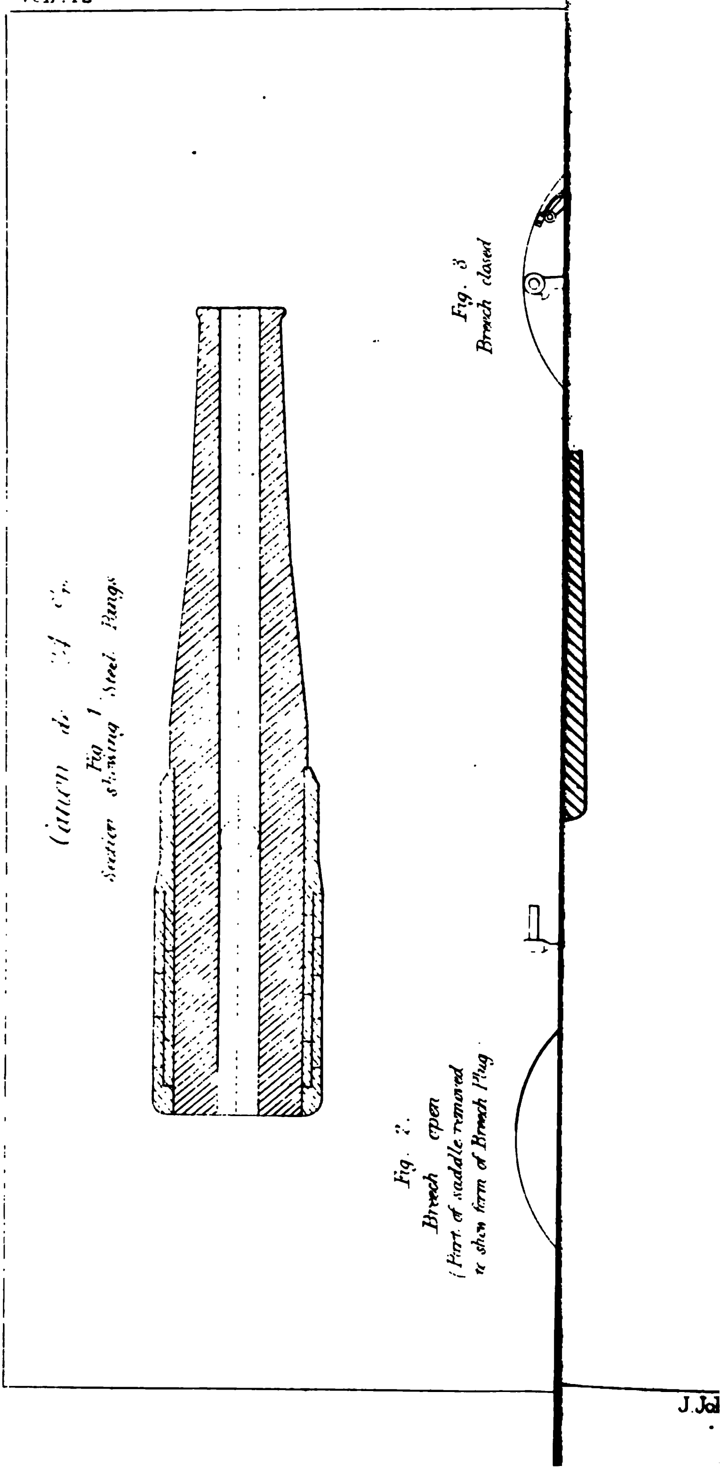


Fig 1
Section showing Steel Rings
Fig. 2
Breech open
(Part of saddle removed
to show form of Breech Plug
Fig. 3
Breech closed

J. Jol

steel rings, supplied to the Government by MM. Petin and Gaudet, the pieces being cast at the Imperial Foundry at Ruelle; they are cast hollow on a sand core. The rings may not at once give way on fracture of the cast iron beneath, but they will not prevent this fracture, and if they should fail, would fly to pieces like cast iron (Plate V, fig. 1).

The weights of the projectiles and charges put down for battering purposes are rather heavier than those used for our heavy rifled ordnance of nearly similar calibre, the French guns being also rather heavier than ours; but it must not be forgotten that the French powder burns more slowly than our own, it is not so pure, and gives less initial velocity; 25 lbs. of English powder being equal in these large ordnance to about 35lbs. of French. With every deduction in strain due to the comparative weakness of powder, I can hardly believe that these large rifled guns of cast-iron, although strengthened with steel hoops, will stand any number of battering rounds. It is, however, but fair to state, on the authority of a French Naval officer, that one of these guns, the *canon de* 24 cm. of 9·45 inches calibre, has fired 1,002 rounds, the last 650 being with 318lbs. projectiles, and 53lbs. charges. This case alone is of little value as to the endurance of similar pieces, for it is well known that unstrengthened cast-iron guns will occasionally exhibit the most extraordinary endurance, but if it can be repeated several times with different ordnance, their construction may be considered reliable. The advantages claimed by the French for their system of manufacture, are facility and rapidity of production, and very small cost.

Besides the rifled guns, a monster 16·5-inch smooth-bored breech-loading piece, made in the same way, was exhibited. It is intended to fire a 660 lbs. spherical shot with a 110 lbs. charge, and weighs 39 tons, or 16 tons more than our 600-pounder rifled gun. Nothing can be learnt of its performance, and it was doubtless made like the 1,000-pounder Krupp, expressly for the Exhibition. Being a smooth-bored gun, with a charge no greater in proportion to the shot ($\frac{1}{6}$) than those of the rifled guns, it is quite, if not more likely, to stand than they are, supposing the casting to be equally sound, which is a more difficult matter with such an enormous mass.

The ordnance that next claim our attention, are those which were exhibited by M. F. Krupp, of Essen, in Prussia. The enormous scale on which M. Krupp's works are conducted will be understood, when it is stated that they cover about 450 acres of ground, about one-fourth of which is under cover; that the number of men employed is 8,000, besides 2,000 more in the coal mines at Essen, at the blast furnaces on the Rhine, and at the iron pits on the Rhine and in Nassau; also, that during last year the produce of the works was 61,000 tons, by means of 112 smelting, reverberatory, and cementing furnaces; 195 steam engines, from 2 to 1,000 horse-power; 49 steam hammers, from 1 to 50 tons (the blocks): 110 smiths' forges, 318 lathes, 111 planing machines, 61 cutting and shaping machines. The establishment has already delivered 3,500 guns, valued at over £1,050,000, most of them being rifled breech-loaders from 4 to 300-pounders.

The 1,000-pounds sent by M. Krupp, was the largest piece in the

Exhibition, that had never been fired. It is a built-up steel gun, with forged inner tube strengthened by rings forged from ingots without welding, and took sixteen months to make, working day and night. We thought £4,000 a very heavy price for our first 600-pounders: what Government would be likely to pay £15,750 for those 1,000-pounders? No purchaser is, however, required, as the monster gun has been generously presented to the Prussian Government.

Next in size to the 1,000-pounder was a 9-inch gun forged in one mass, with the exception of the trunnion ring, from a steel ingot. This, and a 6-inch gun are splendid steel forgings, and were stated to have been subjected to the test of firing, the former 120 rounds with 45lbs. charges, and the latter 100 rounds with 12lbs. charges, but the weights of the projectiles were not given. Some 8-inch steel guns supplied to the Russian Government by M. Krupp were found to stand over 400 rounds, and the 4-pounder field guns exhibited were stated to have fired increasing charges up to 8¾lbs. and 122lbs. shot. There can be no question that the Krupp's steel forgings are admirable, and confidence appears to be placed by both Prussian and Russian Governments in even the very large ones for ordnance; but besides their enormous expense, it is at present doubtful whether uniformity in quality can be obtained in heavy masses of steel, the danger to be feared being, that while some will stand enormous and continued strains, others may fracture suddenly like cast-iron, breaking up into numerous pieces without warning. Many of even the small Prussian field guns burst during the late German campaign, but this was attributed by M. Krupp to the defects in the breech-loading arrangement.

Other steel guns were exhibited by different German manufacturers, but they were generally of small calibre; and a few steel blocks for guns were sent by Russia where three steel factories are being established by the Government.

Sweden showed two heavy cast-iron guns, one, which was rifled, being hooped with steel. I could, however, obtain no information about them.

The United States of America sent none of their powerful smooth-bore ordnance,* but we have little reason to regret their absence, since our own Government has procured one, at the suggestion, I believe, of the enlightened President of the Ordnance Select Committee, Brigadier-General Lefroy, the performances of which you have all, no doubt, watched with great interest. The guns manufactured on the Rodman plan are magnificent castings, and, as we all know, most formidable pieces for short ranges. They have also, no doubt, been produced at a comparatively small cost. It is not easy to ascertain what has been done lately in the way of rifled ordnance in America, but the following statement occurs in the "Annual Report of the Secretary of War," for 1866. "The experiments which have been carried on at "Fort Monroe Arsenal, to test the power and endurance of the 8-inch "and 12-inch rifle guns, made of cast-iron by this department, are

* A table of them was given in my last lecture, and will be found at p. 358, vol. ix, of the *Journal of the Royal United Service Institution*.—C. H. O.

"highly satisfactory, and warrant the belief that cast-iron rifle guns of "these calibres may be introduced into the military service with safety "and advantage. The 12-inch rifle throwing a projectile of 600 lbs., "and with 55 lbs. of powder, has been fired 390 times. It is believed "that no rifle gun of this calibre has ever given so great endurance. "The further trial of these guns will be continued." With regard to the latter part of this passage, I will remind you, that 55 lbs. is a very small charge for a 600-pounder. We have fired charges of 90 lbs. from a 600-pounder, although 75 lbs. will probably be the limit in future. Besides this, however, we must remember that 55 lbs. of American powder is equal to very little more (about 45 lbs.) than the quantity of English powder used with our 9-inch guns. I do not mean to deny the formidable power of the American 600-pounder, but to point out that with a charge of little over $\frac{1}{11}$, 390 rounds is no great performance after all.* In fact, I believe our smooth-bored cast-iron guns would, if rifled, stand charges of $\frac{1}{12}$ or even $\frac{1}{10}$, without being either strengthened or lined.

I have chiefly dwelt upon the materials and constructions for heavy guns, since for small or moderately sized pieces, up to 5 or 6 inches' calibre, no difficulty is experienced in getting the requisite amount of strength and endurance. This was sufficiently proved, although pretty well known before, by the Armstrong and Whitworth experiments, the guns made for which stood over 3,000 rounds, some of the last being with large charges and increasing weights of shot, air spaces being left between the cartridges and projectiles, so as to test the guns as severely as possible. Except in our own service, and in that of Prussia, bronze is still employed for field guns. The Dutch Government exhibited some of their old smooth-bored, cast-iron and bronze ordnance converted into rifled guns by lining with bronze.

If we now turn to the questions of rifling and loading it will be seen that there is much diversity of opinion among artillerists respecting the relative advantages of different systems. In our own service, the smaller natures of rifled guns are breech-loading, with soft-coated projectiles, and the larger pieces and very small mountain service guns, muzzle-loading with projectiles provided with studs, the general opinion being also in favour of the latter system for small as well as large rifled ordnance.

Mr. Whitworth adheres to his modified hexagonal bore with hard projectile, but Sir W. Armstrong accepts the Woolwich system of rifling for his large pieces.† Mr. Mackay's method of obtaining rotation, by placing sawdust between the cartridge and shot, was not represented.

In France the smaller rifled guns are muzzle-loading with studded projectiles, while the heavy are breech-loading also with button projectiles. In the Dutch, Belgian, Spanish, and Swedish services muzzle-loading guns with button projectiles are used. In Prussia and Russia

* It has been stated that the 20-inch American gun has been fired with 200 lbs. charges, and 1,100 lbs. shot (*Army and Navy Gazette*, 22 February, 1868).—C. H. O.

† Sir W. Armstrong is now supplying the Austrian and Italian Governments with heavy ordnance, made on his principle and rifled on the Woolwich system.—C. H. O.

breech-loading with soft-coated projectiles is employed for both light and heavy guns. In Austria the guns are muzzle-loading, but the projectiles have soft coatings with projecting ribs to fit the grooves in the bore of the piece.

With respect to different systems of rifling, which have occasioned so much confusion and mystery, I will repeat what I said here before, that the system is not of such very great importance; good results as regards accuracy of fire may doubtless be obtained with most of them, if both guns and projectiles are manufactured with equal skill and care. The great thing after all is to get a strong and enduring gun, and then to adopt a system of rifling which shall fulfil the following conditions:—

1. Simplicity.
2. Non-liability of projectile to jamb either in loading or firing.
3. It must not entail too great strain.
4. But will allow of the use of large charges.

It will not be necessary to say anything about the two Armstrong systems of *breech-loading* in the service, and I will therefore confine my remarks to a description of the French and Krupp systems, which were exhibited in Paris.

The bore of the French gun is closed by a steel plug, with a thread in its exterior surface, fitting into a screw in the breech of the piece (Figs. 2 and 4). The thread does not extend round the plug, but it consists of three separate equal portions, which together cover one-half of the surface of the plug; the thread is removed from the three intervening spaces, and this is also the case in the breech. The plug can therefore be easily entered, its screwed portions passing up the plain surfaces in the breech; but when pressed home and turned through an eighth of a circle, the threads of the plug enter those in the breech, and the plug is secured in its place. To prevent the escape of gas, a steel cup, which requires changing after about 200 rounds have been fired, is attached to the front of the breech plug, but does not turn round when the latter is screwed in or out.

The plug, when withdrawn from the gun, is supported on a saddle or tray attached to the breech by hinges, so that it can be turned round through a quarter of a circle to allow of the piece being loaded. The projectile is loaded in a bearer, which projects over the screw to prevent its being injured, and is guided into its place by means of a directing groove extending through the chamber to the rifling. A seaweed wad is inserted between the shot and charge. The lanyard passes through a movable eye attached to the breech, and cannot be pulled until the plug is home (Fig. 3). The eye is kept down by a spring, so as to nip the lanyard, until the lever, which screws the plug into its place, has been pressed down, and coming in contact with the eye, raises it. This system of breech-loading, which is used for the four naval rifled guns and the monster smooth-bore piece, is said to work easily and to be secure.*

* The French have an iron-clad vessel, purchased I believe from the Americans, which mounts four of the 27-cm. guns.—C. H. O.

Krupps Cylindrical Wedge

Fig. 5. 9 inch B.L. Gun

Horizontal Section

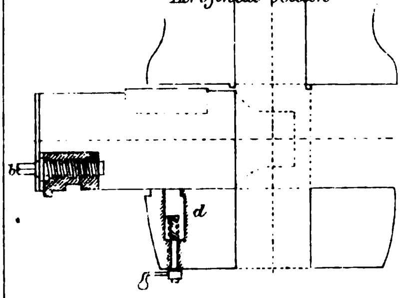


Fig 6.

Side View

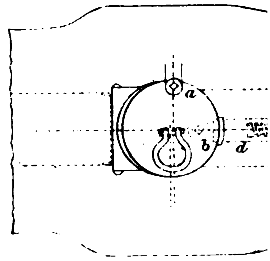


Fig. 7

Vertical Section.

a Screw for moving wedge in & out

b Screw for tightening wedge

c Nut for tightening screw

d Catch-pin

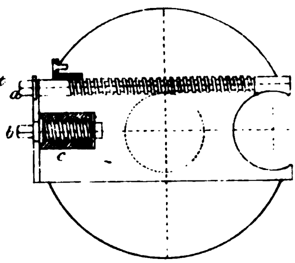
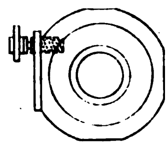


Fig. 8

Rear of breech



Krupps semi-Cylindrical Wedge

B.L. System

(for Field Artillery)

Fig. 9

Side of breech

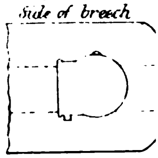
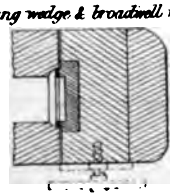


Fig. 10.

Section of Breech

(showing wedge & broadwell ring)



M. Krupp showed several systems of breech-loading, two of which are novel and well worthy of notice. One of these breech-loading arrangements was in the nine-inch gun, and the other in a four-pounder, and in both there is but a single wedge. The apparatus in the nine-inch gun consists of a simple cylindro- or round-backed wedge, the flat front surface forming the bottom of the bore (Figs. 5, 6, and 7, Plate VI.) It can be quickly moved in or out by means of a screw in the top of the wedge, working half in the latter, and half in a nut let into the metal of the gun above. To force the wedge completely home, another screw in the back of the wedge is, however, necessary. The nut in which this second tightening screw works has a certain amount of play, right or left, but it can be rendered immovable by the head of a catch-pin, behind the wedge and at right angles to it, being screwed forward into a slot cut in the back of the nut. The nut being thus fixed, after the wedge has been nearly brought into its place by the first screw, the point of the tightening screw pushes the wedge home. A shot bearer is attached behind the breech, through which a wooden loading box, with the projectile in it, is inserted, and the shot thus prevented from catching in the wedge-slot. It is said that the Russians have adopted this system of breech-loading for heavy rifled ordnance. The advantages claimed for it are simplicity, uniform distribution of strain, no angular surfaces, and strength. When I saw it in the Exhibition it could be easily and rapidly worked, of course without being fired. The escape of gas is prevented by the use of a copper cup, placed in after loading. When lately tried in Austria, the copper cups were not found to answer; but by substituting the Broadwell ring for them, this breech-loading arrangement answered perfectly.*

The breech-loading arrangement of the four-pounder differed in several respects from the nine-inch (Figs. 8, 9, and 10). The wedge is round behind, but rectangular in front, and works in a slot running across the breech. The wedge is provided on the left side with a screw turned by a lever handle; this screw works into a thread running across the breech over the wedge, which is brought into its required position by turning the handle. A locking-pin drops down from the top of the breech into a shallow groove in the upper surface of the wedge, and keeps the latter securely in position. On the face of the wedge is a steel (Broadwell) ring, which, when home, fits against a similar ring in the bottom of the bore, and prevents the escape of gas. This appears to be a very simple and excellent arrangement, and can, no doubt, be worked with facility and safety.†

* "The breech-loading apparatus, in the first guns sent by Krupp, did not "answer all just demands as the copper cups required the greatest attention and did "not prevent the jamming entirely, but since the introduction of Broadwell's ring, "which remains serviceable far beyond a hundred rounds, prevents entirely every "escape of gas with its elasticity, and requires no attention at all, Krupp's *Rundkeil* "*verschluss* is really perfect." (Extract of a letter from Count Kielmansegge, an Austrian Naval Officer.) The Broadwell ring gave perfect satisfaction in Russia.—C. H. O.

† A Russian general officer informed me that his Government were casting a large number of bronze field guns, which would have the breech-loading arrangement of this 4-pounder.—C. H. O.

There were several guns exhibited having the Wahrendorff and other breech-loading arrangements, but these need not detain us.

I will now say a few words on gun carriages, in the materials and constructions for which, many changes and modifications have lately been introduced. As our ordnance have increased in size and weight, greater strength has been required in the carriages, and additional mechanical appliances for working them with facility. The necessary conditions—strength, durability, facility of working, and control of recoil—are obtained without difficulty in a carriage for a gun of comparatively small calibre; but for pieces weighing many tons, and firing heavy projectiles with large charges, it is no easy matter to combine these conditions. By the substitution of wrought iron for wood, sufficient strength and durability, without unwieldiness, can doubtless be secured; and it must have been noticed in the Exhibition that wood has been entirely discarded as a material for the gun carriages of heavy ordnance.

Much attention having been devoted in England to the question of muzzle-pivoting, it was disappointing not to find any carriages on this principle, or even designs or models, either in the War Office annex, or in that of the private British exhibitors, although several excellent models were shown by Prussia and Austria. There were some small models to illustrate Captain Heathorn's method of muzzle-pivoting in the building of the British naval exhibition, but being small in size, and not properly labelled, they may not probably have attracted much attention. Mr. R. Mallet, C.E., who has paid so much attention to artillery matters, and is the author of the able work, "The Physical Conditions involved in the Construction of Artillery," proposed some years ago several designs for muzzle-pivoting, and more recently a carriage contrived by Lieutenant-Colonel Shaw, R.A., for a 68-pounder, has been tried with success. There were also no models or drawings of another carriage on an entirely novel principle, and which appears to offer several advantages. I allude to Captain Moncrieff's counterpoise carriage. It will not be necessary for me to describe it, as the inventor has himself explained the construction here. I will only state that a carriage is now being made in the Royal Carriage Department, under the personal superintendence of Captain Moncrieff, and that we shall all, I feel sure, look forward with great interest to the results of experiments with it. Should such carriages work satisfactorily, batteries can be made for them without embrasures or shields.

It will not be necessary for me to describe our service iron carriages, their construction, the compressor arrangement, and other details having been explained here; besides, there are, no doubt, many in this room who, having been at Woolwich, Shoeburyness, Portsmouth, or the Paris Exhibition, have had ample opportunity of examining them. I will only then remind you that we have numbers of excellent wrought iron carriages for our heavy rifled ordnance, that garrison carriages of the same material, but of lighter construction, have lately been adopted for 64-pounder rifled, 32-pounder, and 8-inch smooth bored guns, that we possess iron sling waggons for moving our heavy guns, and that steel carriages for the small mountain guns were lately sent to Abys-

sia. Sir W. Armstrong exhibited an iron field gun-carriage which had many excellent points, besides a box-girder carriage for his 9-inch gun.

The wrought iron carriage for heavy rifled ordnance shown by the French had box-girder brackets, but the method of elevating the gun, and of giving compression to the carriage, differed from ours.

The breech of the gun is supported on a chain suspended between the brackets, this chain can be raised or lowered by turning two handles, one outside each bracket. The compression is given on both sides by a brake of gun-metal embracing the side piece of the slide, the thickness of which increases from front to rear, so that the compression becomes greater as the piece recoils.

M. Krupp showed the wrought iron field carriages* used in the Prussian and Russian services respectively. Spain also showed models of field gun carriages, sling waggons and carts, and devil carriages, all of wrought iron.

It only remains to consider the ammunition now used by artillerymen. This term *ammunition* includes an enormous quantity of stores and projectiles of all kinds, besides fuzes, cartridges, wads, and tubes, but I shall only refer briefly to those which have been recently introduced taking it for granted that you are familiar with the rest.

In the first place there are the Palliser projectiles, both shot and shell, employed, as you are aware, for the penetration of iron defences, for which purpose they have answered so remarkably well. As a material for firing against thick iron armour, ordinary cast iron is useless, breaking up without producing injury. Wrought iron is too soft, a great proportion of the work on impact being expended in flattening out the shot. Steel answers well, but is enormously expensive. The essential feature of the Palliser projectiles is that, being made of carefully selected brands of iron and chilled in casting, they possess intense *hardness*, the property requisite in projectiles fired at iron plates with high velocities. Besides, however, this property, they have a pointed (*ogival*) head, which both theory† and practice appear to prove is the most favourable form for the penetration of iron masses. An additional and most important advantage is the cheapness of the manufacture of these projectiles, their cost being about one-fifth of that of similar steel projectiles. The steel projectiles shown by M. Krupp and others had also *ogival* heads.

In the next place is the Boxer shrapnel for rifled ordnance, in which the essential features of a shrapnel shell are embodied. Such a shell fired from a rifled gun having, previous to breaking up, a rotatory motion, considerable lateral spread is given to the bullets when released, and in the segment shell this is increased in consequence of the charge being in the middle of the shell.

In the Boxer shrapnel the charge is placed in a chamber at the base,

* The unwieldy carriage of the 1000-pounder was a mere bed.—C. H. O.

† General Mayefski, of the Russian service, has written a mathematical memoir on this question which was reviewed by Mr. Mallet in the early numbers of the *Engineer* of 1867.—C. H. O.

so that on explosion there is no tendency to increase the lateral spread of the bullets, but rather to impart higher velocity and therefore to give greater penetration. A tube leads the flash from the fuse to the bursting charge. The shell is filled with bullets of lead imbedded in rosin. The spherical form and density of the bullets are better for range and penetration than the angular form and light material of the segments.

The Austrians have also shrapnel shell on the same principle, with the bursting charge at the back of the shell.

The ingenious rocket lately proposed by Mr. Hale, and now adopted into our service was also exhibited. In the base are three vents, and round one side of each vent is a circular metal plate projecting about two inches from the base; when the gas issues from the vents its pressure on the plates causes the rocket to rotate, and gives its longer axis stability during flight, thus avoiding the necessity of using a stick. These rockets are very accurate in flight.

Before leaving this part of the subject I must also remind you of the Boxer life-saving apparatus, consisting of a double rocket, which is intended when fired to carry a line to a wreck. You will probably have noticed in the newspapers that by the employment of this apparatus many lives have been saved during the late storms.*

Before concluding, I must say a few words respecting the Gatlin Battery, which attracted considerable attention in Paris. It consists of a frame, mounted on a gun-carriage, and supporting six rifled steel barrels, which can be made to revolve, so as to bring each in turn opposite a chamber, by a handle at the side of a cylinder behind the chamber. In the cylinder is the mechanism for firing the cartridges, which is effected by the blow of a pin on a portion of detonating composition in the base of the cartridge; and an extractor advances as the barrels turn and withdraws the cartridge-cases. Twenty-five charges placed in a tin case drop one after another into the chamber through a gun-metal guide above; one battery throws bullets of about ½ lb., and a smaller one bullets weighing 1¼ oz. The battery is intended to fire a continuous stream of bullets towards the same point, and thus to supply more effectually the place of an ordinary gun, throwing case or grape shot. General Gilmore reported favourably on a somewhat similar weapon, called a *requa* battery, used at Charleston; it had twenty-five barrels, which, by means of a lever, could be diverged so as to scatter the balls according to the range. The effect of the fire of the Gatlin battery is said to have been far greater than that of a 24-pounder howitzer, when tried in America; but at Shoeburyness this superiority (over the case shot of a 9-pounder rifled gun) was confined to very short ranges. Like all weapons constructed for continuous fire, the Gatlin batteries might prove very formidable in the defence of short flanks, breaches, bridges, streets, and other confined situations, but can never supersede ordnance for ordinary war purposes.

In the brief review I have given to-day of the present condition of

* 14 persons saved at Poor Head, county Cork, 3 men rescued at Holyhead, and 11 persons at Bardley, Yorkshire.—C. H. O.

artillery, I have been compelled to omit many things which I should have liked to have touched upon, one of these being the chronograph contrived by the Rev. F. Bashforth for ascertaining the respective velocities of a projectile at different points of its trajectory. If any of you wish to see a brief description of this instrument,* and a more detailed account of the guns, carriages, and ammunition exhibited at Paris, you will find them in my Report on the Exhibition.

I have not attempted to go into the question of iron defences,† as the time allowed is barely sufficient to consider very briefly the subject of artillery. I will only make one or two remarks with reference to them. It certainly does seem strange that, although possessing so many fine iron-plated vessels, we have as yet no adequate protection in the way of floating batteries for harbour defence; batteries I mean that are invulnerable to the fire of any guns which can be carried by sea-going vessels. As regards land defences, batteries might also be made, without difficulty, shot proof, but this has not yet been done. It is to be hoped that the failure of the Gibraltar shield will prove a lesson to those intrusted with the construction of our fortifications, and prevent them in future from ignoring the results of experiments for the sake of a false economy.

In conclusion, I think it is only fair to bestow a few words of praise on the artillery *matériel* exhibited by the War Department. Notwithstanding the harsh criticisms, amounting in some cases to pretty strong abuse, passed not unfrequently in this country upon those intrusted with artillery matters, our Government did not disgrace itself, but on the contrary displayed an exhibition of ordnance and their appliances, which was most complete and perfect in every way, and admirably arranged for inspection. I can say this without fear of being accused of self-praise, for I am not employed either at the War Office, in a manufacturing department, or on any Committee, and my work at the Royal Military Academy rather tends to encourage a critical spirit. At the same time, having myself conducted a great deal of gun practice, both on service and at home, having had the best opportunities of witnessing the progress of military manufactures and also of watching all the experiments in connection with them, I can hardly be accused of presumption in giving an opinion upon the state of our armaments.

I will not however merely give you my own opinion, but will remind you of the praise bestowed upon our war munitions by an eminent civil engineer, Mr. John Fowler, who when presiding at the annual dinner of the Institute of Civil Engineers, in May last year, thus expressed himself, "I cannot refrain from one word of reference—and I "do so with pride—to the collections of munitions of war and specimens "of marine engineering, which are now displayed in the English de-"partment of the French Exhibition. I confess that the conclusion

* Mr. Bashforth has printed a full description of his chronograph (published by Bell and Daldy 1866).—C. H. O.

† A number of iron targets, which had been fired at, were exhibited by the British, French, and other nations.—C. H. O.

"which I drew from my examination was this (and I hope all other "examiners will draw the same conclusion), that it would be a wise "and prudent thing to be at peace with that country and that people "who can supply such munitions of war."*

I think that we may be well satisfied with the present method of manufacturing our ordnance, which promises to ensure strength and endurance at a moderate cost. Our systems of rifling, except the shunt, which is confined to a single gun,† may also be said to be satisfactory. No one accustomed to artillery practice would deny that our rifled ordnance, both breech-loading and muzzle-loading can be served with ease and security, and that their fire is exceedingly accurate. I do not say that they have no defects, or that equally satisfactory results might not have been obtained in other ways, and at a less cost, or that improvements may not be adopted with advantage; but that they are good serviceable weapons, and in all probability quite a match for those that may be opposed to them, no one competent to give an opinion would, I think, deny.

The question of breech-loading for heavy ordnance intended for cupolas or casemates may perhaps be not yet finally settled: and although I should be sorry to see the introduction of fresh systems into the service, circumstances might arise to create a demand for heavy breech-loading guns, and I confess that I should like to see both the French and Krupp's (latest) systems tried in this country.

Neither with our carriages nor our projectiles need we be dissatisfied, but much remains to be done in the investigation of the best descriptions of powder for our large rifled guns, and in the simplification of our *matériel* generally, which in these transition times is like that of other powers who have done anything lately, far too complicated. Every effort should be made to reduce the numbers of different natures of ordnance and projectiles with their accessories, for in a service like ours, scattered all over the world, a complicated *matériel* cannot possibly be understood, or therefore efficiently employed. Simplicity is also essential in the design of a gun, a carriage, or anything else intended for military purposes, for with complex constructions, the most trifling circumstances may render an apparently perfect mechanism utterly useless.

Frequent changes for the sake of trifling improvements or advantages have for the last few years been the bane of the Service. They were chiefly attributable to a cause that no longer exists, although minor ones still continue to operate to some extent. The complication in our *matériel* is no doubt mainly due to the fact that we have been passing through a transition state; but it must not be forgotten, that just when an able and responsible chief was required, there was no Director-General of Artillery, or other principal officer entrusted with the important charge of *matériel*; that the Superintendent of the Gun Factories was summarily got rid of, and replaced by an inventor and Government contractor (a very able man, I acknowledge, and one to

* *Times*, 9th May, 1867.

† The muzzle-loading 64-pounder.

whom we owe much), who was made virtually Director-General of Artillery; and that all the experience of the service was set aside, as if a gun had never been made, or at least fired. The wonder is that our munitions of war are not more complicated, and that we have not sacrificed more millions upon them, but it is satisfactory to know that efforts are now being made to simplify our military stores.*

Although then we may, I think be well satisfied with our own armaments, we must not fail to keep a strict watch on those of foreign powers, and to provide amply against them, in order that we may be able at any moment, in these threatening times, to defend our country, to protect our commerce, and to maintain our present high position among the nations.

* 55 different natures of smooth-bore cast-iron or bronze ordnance (guns, mortars, howitzers, and carronades), varying in size from 10″ calibre to ½-pounder, have recently been declared obsolete. There still remain in the service about 62 different natures of smooth-bored cast ordnance from 10″ to 3-pounder besides the two large built up smooth-bored guns. There are 12 different breech-loading and 10 muzzle-loading rifled guns in the service. The ammunition is necessarily more complicated, every fresh gun added to the service entailing the supply of several projectiles, cartridges, &c. There are 22 fuzes of different kinds, not counting several patterns of the same fuze; besides these, there are 4 fuzes, of which no more will be made, but certain numbers of them are still in the Service.—C. H. O.

Rifled Ordnance over 6-inch Calibre exhibited in Paris in 1867.

Gun.		Calibre.	Weight.	Charge.		Projectile.		Remarks.
				Service.	Battering.	Weight.	Bursting charge of shell.	
		inches.	tons. cwt.	lbs.	lbs.	lbs.	lbs.	
British Service. Muzzle-loaders.	12-inch ..	12	23 0	..	..	600		
	9-inch ..	9	12 0	30	43	250	18	Sir W. Armstrong and Co. exhibited a 9-inch gun similar to the service 9-inch muzzle-loading piece.
	7-inch ..	7	6 10	14	22	115	8¼	
	64-pounder	6·3	64	6	8	64	4½	
British Service. Breech-loaders.	7-inch ..	7	82	11	..	90	6¼	
	64-pounder	6·4	61	6	8	64	4¼	
Whitworth muzzle-loading 150-pr.		7	7 8	20	..	150		
French Service Breech-loaders.	Canon de 27 cm.	10·82	21 13	53	66·2	Steel shot - 476 Cast-iron shell 310	..	French powder much weaker than British.
	do. 24 cm.	9·45	13 16	35·3	52·9	Steel shot 317 Cast-iron shell 220	..	
	do. 19 cm.	7·64	7 17·6	17·6	27·5	Steel shot 165 Cast-iron shell 115	..	
	do. 16 cm.	6·48	4 18·5	11·0	16·5	Steel shot 99 Cast-iron shell 695	..	
Krupp's Breech-loaders.	1,000-pounder........	14	50 0	110	130	Shot 1212 Shell 1080	17	
	9-inch	9	12 5	40	50	Shot 330 Shell 275		Could obtain no information respecting the 9-inch Swedish gun.
	6-inch	6	85	10	12	90		
Swedish muzzle-loading, 9-inch ..		9						

Evening Meeting.

Monday, March 16th, 1868.

Major General the Hon. JAMES LINDSAY, Vice-President, in the Chair.

Names of MEMBERS who joined the Institution between the 2nd and 16th of March.

ANNUAL.

Hill, Sir William, K.C.S.I., Major-Gen. ret. Mad. Army. 1*l.*
Bluett, W. H. P. Gordon, Major 10th Regt.
Flower, Stephen, Lieut. 13th Light Infantry. 1*l.*

CARTRIDGES FOR BREECH-LOADING SMALL-ARMS, AND THE BEST FORM OF PROJECTILE.

A Paper prepared by Captain J. B. O'Hea, late 25th Regiment, and read by Major-General Boileau, F.R.S.

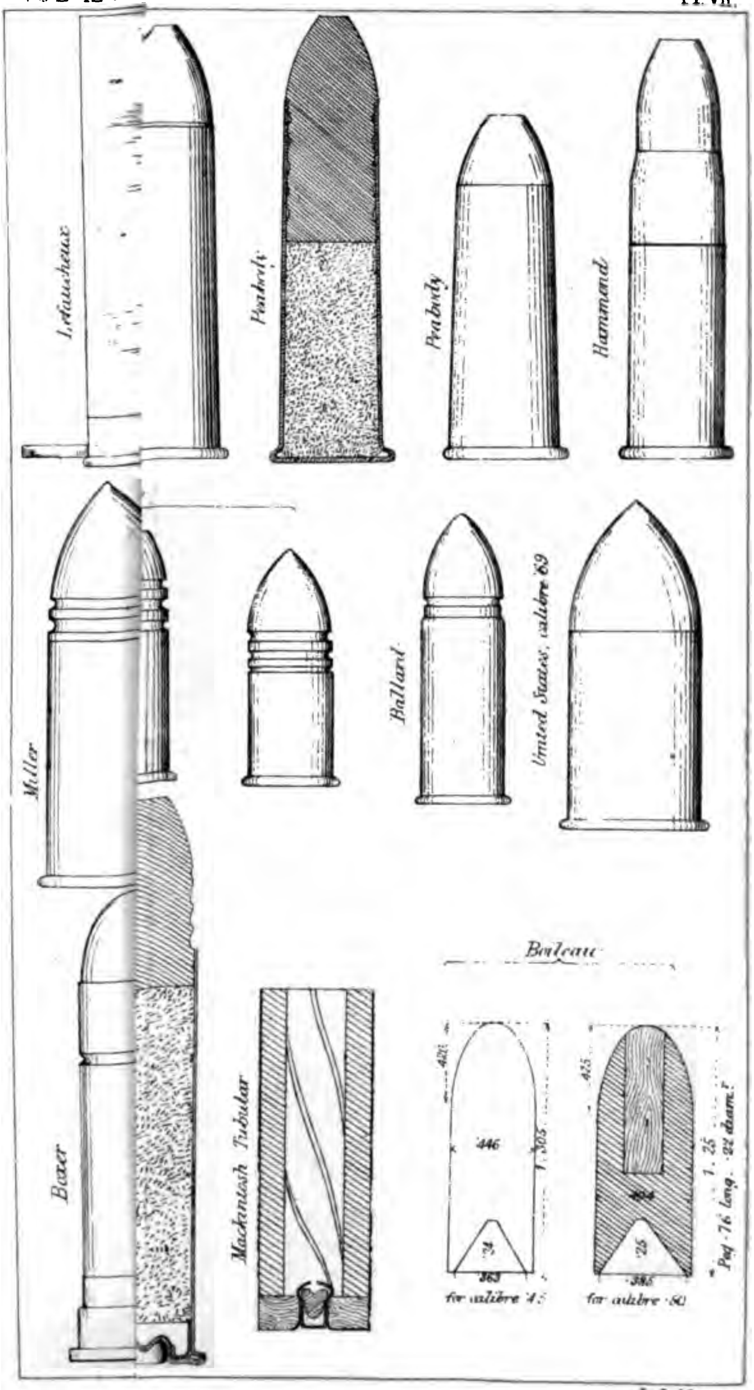
Amongst the inventions for which the past few years have been remarkable, breech-loading small arms take a prominent position in importance, ingenuity, and number; provisional protections or letters patent having been granted in this country during the year 1867 alone, for no fewer than ninety-eight descriptions of the arm. Great ability and mechanical skill have come forth in the production of this weapon; but in the perhaps more attractive pre-occupation of invention, the excitement of competition, or from some other unexplained cause, the cartridge—not a less essential element—appears in many instances to have been overlooked, and the projectile all but forgotten, or only noticed to be modified or altered out of all recognition to meet the necessities of the arm or powder charge. Some remarks, therefore, on "cartridges for breech-loading small arms, and on the best form of projectile," put forward

by one who is not so fortunate as to be himself an inventor, or so presumptuous as to question the inventions of others, may not be out of place just now at the Royal United Service Institution or altogether devoid of interest elsewhere.

Exception might be taken to the title of this paper. It may be considered by some who are trained to use the rifle, and interested in its improvement, that the subject of ammunition, apart from that of the arms for its use, affords but little opportunity for investigation or discussion. A few even may be inclined to question the influence which the form of projectile has on its range or penetration, or the near relationship of its weight to the calibre of the arm, and powder charge for its propulsion; should such objections be contemplated or advanced, I can but reply, that the ammunition is the primary invention in point of date and importance—that the cartridge contains the life of the arm, and gives to the weapon its distinguishing excellence for range, penetration and in some measure for accuracy; the arm, however perfect, can only be remarkable as ingeniously-contrived time- and labour-saving pieces of machinery for carrying out that invention. For as the knowledge of the peculiar power of the composition now known as gunpowder led to the production of weapons for its utilization, and the discovery of fulminate of mercury, early in the present century, caused a material change in the arms of later years, so the invention of a cartridge containing its own means of ignition, has brought about an entire revolution in the construction of the military small arms of the present time. The cartridge therefore, now, as heretofore, claims precedence.

I hope that there are present this evening few, if any, who are not alive to the primary importance of judiciously weighted ammunition with a properly formed projectile. I see amongst those whom I have the honour to address, not a few who understand from experience what a secondary part the arm has to perform, when range, penetration, and in some cases accuracy, have to be obtained. Lest, however, there should be any one here who dissents from the divided subjects, "ammunition" without "weapons," I beg to say that I have a number of weapons breech-loaders and repeaters, some taken from the valuable collection in this Institution, others of more recent invention not yet known to the public, but entrusted to me for exhibition this evening the mechanism of which, as essential to the perfect understanding of the subject, I will, whilst reading my paper, so far as time will admit endeavour to explain in connection with the more immediate object which I hope to illustrate, viz.: the question of ammunition; or at the close of the discussion, with the permission of the Chairman, I shall be prepared to afford to any one wishing for specific information with regard to any particular arm, such elucidation as a previous acquaintance with it will enable me to supply.

It is not my intention to trespass on you with a history of self igniting ammunition from its ascertained origin; suffice it to say, that a cartridge containing its own ignition is by no means a recent discovery, for in 1831 Monsieur Robert made known his invention of such a cartridge, and in 1836 a Parisian named Lefaucheux, introduced


Lefaucheux
Peabody
Peabody
Hammond
Ballard
United States, calibre '69
Boxer
Mackintosh Tubular
Boileau
for calibre '45
for calibre '80

J. Jobbins.

the pin-fire semi-metallic cartridge (see Plate VII), lately in general use with sporting arms, and which, together with Potet's anvil cartridge, has been the predecessor of the many improvements and modifications in central fire ammunition at present in general use with smooth bore and rifled arms. But it might be a fact worth noticing by those curious in the mutability of human opinion, that this very description of ammunition, now deemed an essential in the equipment of the armies of every nation of importance in the world, was from the fact of its carrying its own means of ignition, until very recently pronounced unsafe and consequently unsuitable for the use of troops by all European powers, with the exception of Prussia, which adopted the paper-cased cartridge, containing its own fulminate used with the lately famous needle-gun. This cartridge gives to that arm the only merit of the invention, namely, that whilst the form of the projectile remains unchanged, an excessive or over charge of powder cannot materially alter the range, or whilst the weight of bullet is not increased, give increased recoil; for the point of ignition being at the junction of the powder charge with the projectile, the latter receives the force of the inflamed powder less suddenly than if the cartridge was ignited at the base, and combustion being towards the breech, the great force of the propelling power is applied to a projectile in motion, from it. By this means recoil is greatly lessened, and the excessive force of an over-charge expended after the body being propelled, has left the bore.

The invention, some time since patented by Mr. W. Murphy, for applying the initial force of the powder charge to a projectile previously put, and actually in motion, through the bore, brings plainly before us the great value of the principle indicated by the Prussian needle-gun ammunition. Probably Herr Dreyse little dreamed of the value of a discovery which will, it is to be hoped, lead the way to a perfect method of loading at the breech, arms of the largest calibre; hydraulic power being adopted as a substitute for manual labour in the loading and working of the guns.

From the parent source, the self-igniting cartridge for breech-loading small arms has come to us in three distinct forms, viz., *the paper or skin-wrapped cartridge, the metallic-cased cartridge, and the bullet cartridge.*

The *first* named does not require, in the construction of the arm for its use, mechanism to extract or remove from the breech-chamber any portion of the cartridge-casing or wrapping which it is intended should be consumed with the powder or carried away in the discharge; but it throws on the weapon the entire duty of preventing gas escape breechwards, necessitating for this purpose, mechanism more or less complicated or perishable. The only exception to this rule, that I am aware of, is the paper-cased cartridge, lately invented by Mr. Green, of Blandford-street, Portman-square, which is so constructed as to divide with, if not relieve altogether, the arm of this duty.

The *second* named, the metallic-cased cartridge, while preventing gas-leakage breechwards, requires from the arm assistance in removing the metallic shell from the breech-chamber after each discharge. For this purpose at least one extra piece of mechanism is necessary

in the breech arrangements of every description of breech-loader I have been able to examine, with one exception, viz., the arm using the Selwyn cartridge, the metallic case of which is made, by the forcing of the rim into a groove by means of the explosion of the powder charge and the resistance to initial motion thus offered by the projectile, to cause its own retraction on the breech-block being opened.

The *third* description (the bullet-cartridge) is that in which the projectile is either made to contain its own means of propulsion, or is a metallic cylinder or powder-case containing the charge for propelling by means of a wooden wad, another cylinder of like form and weight, the powder-case, in its turn, becoming the projectile after discharging its contents; the ignition being by means of fulminate, placed in the wad.

Of the first class of ammunition (the paper cased or wrapped), there being but few varieties, I am unable to produce here to-night more than three specimens, namely, the Prussian needle gun-cartridge already referred to; the Chassepot for use with the French arm of that name; and the cartridge lately invented by Mr. Green, for use with his improved breech-loader.

The *first*, the *Prussian* (see Plate VII), which I shall call central-front-igniting, is a paper-wrapped cartridge, weighing 615 grains, and composed of four parts, viz., 1st. The projectile, solid, of lead, ogive-shaped, weighing 481 grains. 2nd. The papier-maché sabot, weighing, with the fulminate, which is placed in its base, 54 grains.. The bullet, in calibre, much smaller than that of the arm, is imbedded in the front of this sabot, which fits the boring tightly, and is intended not only to bar gas escape round the projectile in its passage up the barrel, but to carry it on the rifling with its longer axis co-incident with the axis of the bore; thus imparting to it the after-rotation necessary for steadiness of flight. After leaving the barrel this sabot, from its lightness, recedes from the projectile, being removed by atmospheric pressure, and it is therefore a question how far, in consequence, it affects range and accuracy. 3rd. The powder charge, weighing 70 grains, the graining of which is very fine, intended to offer but slight resistance to the passage of the needle, and gives quicker combustion than powder of larger grain. 4th. The paper wrapping, weighing 10 grains. Total length about 2 and 10-100 inch. As can be perceived by an inspection of this cartridge in connection with the arm for its use, the provision against gas escape through the breech works is imperfect, as well as against misfire, caused by the deflection of the needle in passing through the powder charge, and consequent failure in striking the fulminate.

The *second* named, the Chassepot-cartridge (see Plate), is ignited in the centre of the base, and may almost be designated semi-metallic, as the priming, which is contained in a cap, like that generally used with the smallest class of nipple arms, being perforated to give passage to the spark, is protected by a metallic washer, placed inside the base of the powder-case, which latter is paper, rolled on a mandril, and pasted at the edges. The powder-charge being inserted, is pushed down gently to give rigidity to the cartridge—a marked peculiarity in this ammuni-

tion.* A wad, formed with an opening in the centre, is placed on the powder, into which opening the twisted end of the powder-case is inserted, and the projectile, wrapped in a paper jacket, pasted at the base only, is connected to the powder-case by a thread, passed round a groove, slightly behind the wad; finally the cartridge is greased. This cartridge weighs 485 grains, and consists of six parts, viz., the projectile of 383 grains, the powder charge of 80 grains, and the casing or wrapping, complete, consisting, with wad, washer, and fulminate, of four parts, 22 grains. Length of cartridge, 2 and 65-100 inches. On examining this ammunition in connection with the Chassepot rifle, it will be seen that it imposes on the latter the entire work of stopping gas-leakage through the breech, which is effected by the compression, under the action of the exploded powder, of a vulcanised caoutchouc washer, interposed between the front face of the breech-bolt and a shoulder or flange on the needle-guide, which is movable.

The *third* cartridge of this class of ammunition (see Plate) (Mr. Green's) is, as I before observed, constructed to check partly, if not altogether, gas escape breechwards. With this object, the inventor has ingeniously applied to his cartridge the principle indicated in the Chassepot gun, and in the well-known arm bearing his name, which fires by cap. In a cartridge case of the usual tough paper, gripping round the centre an Enfield bullet of 530 grains, a charge of powder weighing 70 grains is inserted. On this charge of powder is placed a wad, composed of three layers of cardboard, with a hole punched through the centre, in which hole, fulminate as powder, wrapped in paper, in the form of paste, or in the usual percussion cap is deposited; the first being preferable. An india-rubber wad, perforated through the centre with two small incisions in the form of a cross, is placed on this, and the powder-case is closed at the base by a single cardboard washer, over which paper is pasted, thus completing the cartridge.

I am informed by Mr. Green, the inventor, and by Mr. Cole, gun manufacturer, of Great Portland Street, who has modified the arm using this cartridge, that the india-rubber wad expanding under the pressure of the exploded powder-charge is a most effectual gas-check, the breech arrangements of the arm, after repeated trials, not having exhibited the slightest trace of gas escape from the cartridge, the wad, after each discharge, cleansing out the bore of any fouling. The total weight of this cartridge is 628 grains.†

In favour of the paper or skin-wrapped cartridge, there are generally advanced, facility of manufacture under most circumstances where powder, lead, and fulminate can be obtained, and consequent economy as well as certainty in supply; lightness in weight, and consequent ease in

* In the English school, packing or ramming the powder charge in any cartridge igniting at the base, is considered equivalent to loss of range.—J. O. H.

† I understand that the price of this ammunition will be about seventy shillings per thousand rounds; if packed in small tin cases, each case containing ten rounds, about one halfpenny per case extra.—J. O. H.

transport in large quantities, and to the individual soldier, in carriage; *against it*, liability to breakage, and deterioration in bulk or in the pouch owing to the defective protection afforded by paper wrapping or casing against deformity or damp, and consequent mis-fire, loss of range, and difficulty, if not failure, in loading; danger of ignition of fulminate from percussion otherwise applied than through the arm.*

With these remarks I shall take leave of this class of ammunition.

Of the *second* description the metallic cased cartridge, there is a greater variety, but all may be classed under the heads of simple and compound ammunition, the general divisions or sections of which, whether simple or compound, I assume to be four, viz., the shell, fulminate, powder-charge, and projectile, being entirely simple parts, or sections, in the one—some more or less compound in the other. Under one or other of these heads, come the various forms of the metallic cartridge at present known, whether with punched, folded, or, shall I say, built-up cases; of copper, brass, or other metallic substance; rim igniting, central fire, or convertible to either system, with solid, hollow, or compound projectiles, many possessing some peculiarity or merit to distinguish them, which, in the space of this paper, it would be impossible to notice at any length, without infringing the rules of this Institution. Having no wish, therefore, to make distinction, I am compelled to select for description some particular cartridges more or less familiar to the services, as well as to civilian riflemen, and a few of late invention, foreign as well as British, not so generally known.

1st. According to date of invention, comes the rim-fire copper-case cartridge of the United States.

2nd. The British service cartridge known as the Boxer.

3rd. That more recently patented by Mr. Daw, of Threadneedle Street.

4th. The Selwyn cartridge before referred to; the invention of Captain Selwyn, R.N.

5th. The American copper-cased cartridges, the one known as the National, for use with the national arm: the other called, I believe, the Empire cartridge, both of which are convertible to rim or central fire.

6th. The Berdan Russian cartridge, for use with the improved Berdan arm, the right to manufacture which in Europe, has just been purchased by the Russian Government.

Although, I believe, the punched or drawn metallic-cased cartridge is not, strictly speaking, of Transatlantic origin, (I have here a punched, or drawn, brass shot cartridge case, pin fire, manufactured in Paris some time prior to 1849 (see Plate), yet ammunition of this description was first largely adopted for military weapons by the Federal authorities during the late civil war in America, and was the parent of the many beautiful inventions in breech-loading small-arms every day claiming attention. There cannot, I think, be a doubt but that to the adoption of this cartridge, and the weapons it called forth, may, in a good

* It has been satisfactorilly ascertained by experiment that ammunition in the form of paper-cased cartridges, even containing fulminate when made up in bulk, will not explode en masse on the ignition of one or more units.—J. O. H.

measure, be attributed the closing of the great civil war of modern times.

As far back as April, 1860, simple metallic-cased rim-igniting ammunition was manufactured at Springfield, Massachusetts, for Spencer's Repeating Rifle, since modified into a single loading, as well as repeating arm; and other cartridges of this description had previously been made elsewhere in the United States.* The case is of copper, punched or drawn, weighing with fulminate 75 grains. This cartridge having to be carried in a magazine limited in extent, is short for an arm of 50 calibre, measuring but 1·70 inch.

The Spencer cartridge (see Plate), weighs 480 grains, carries a leaden projectile of 360 grains, and a powder charge of about 45 grains, which the excess of fulminate in the rim is supposed to make equal to 50 grains. Although this weight of ammunition may not exactly succeed in making a long range score at Wimbledon, at ranges within 450 yards, even with the original pattern arm, in the hands of troops more or less practised, it did splendid service for the Federal cause, as the record of Colonel Wilder's famous corps of mounted infantry in the army of the Cumberland bears testimony.

Spencer's improved ammunition and arm have been recommended for adoption in the United States' cavalry by the Board on Small Arms, of which General Hancock was President.

There are here other descriptions of American rim-igniting cartridges for single loading arms, of more recent invention, containing charges varying from 55 to 70 grains of powder to propel from 380 to 450 grains of lead, the cases of which are more or less coned from base to projectile, in order to facilitate extraction and admit of an average charge of powder being contained in a cartridge of medium length. Such are the Peabody (see Plate), the Joslyn, the Hammond (see Plate), and the Remington (French and Danish).

The second named, the Boxer cartridge (see Plate), for which distinct patents were obtained in January and October, 1866, is too generally known to call for an extended or detailed description. It is a compound cartridge, central fire, two and a half inches in length, weighing about 700 grains, contains 70 grains of powder, to propel a projectile composed of lead, wood, and clay, weighing 480 grains. The case is built up, being composed (including the percussion cap) of three descriptions of metal, and of nine pieces; namely, the cap-chamber and the anvil (which are brass), the cap for fulminate (which is copper), the base disc, or washer, which is iron, and in consequence less likely to fracture or give way than brass, when force has to be used in its extraction, the base metal cup, the cartridge body or coil, with the paper wrapping, a second metal base cup or coil, an additional base coil, the latter intended to regulate the relative resistance in expansion of the cups and coils and prevent the cutting through of the body of the case at the time of firing; lastly, the wad, cup-shaped, composed of papier-maché, lead and tin, or an alloy of lead and antimony the con-

* The cartridge for Ball's carbine (the first arm invented, which combines the power of repeating and single loading,) is of this short description, weighing but 475 grains.—J. O. H.

densing of which securely fastens together the base disc, cap-chamber, and body of cartridge. There is also a space between the powder and the projectile, containing wool or cotton wadding, which lessens the initial shock of the powder-charge on the projectile, and consequently somewhat diminishes recoil. This cartridge is used in a breech-chamber considerably larger than its diameter, by which it is intended to obviate all difficulty in loading even when the cartridge is in a deformed state; and the case being uncoiled by the explosion, instead of being expanded, is supposed to be not only a preventative to gas escape breechwards, but also a security against fracture or splitting of the metal. The arrangement of the anvil with shoulders or projections, which prevent it from passing into the cap, and keep the point of the anvil at a safe distance from the fulminate, is new, and intended to obviate all danger of ignition when the cartridge is dropped accidentally, or subjected to any other blow than through the striker of the fire-arm, or that which indents the back of the cap.

It not being my province or intention to offer an opinion on particular inventions or modifications, I shall only state that of the nine arms chosen by the Special Commission to compete for the rewards offered by the Secretary of State for War for the best breech-loading small-arm fulfilling certain conditions, six used cartridges on the Boxer coil principle.

The next cartridge (see Plate), (the property of Mr. Daw), which, in consequence of his system of casing made known in 1866, I have named *third*, although the remainder of the invention was, I believe patented as far back as 1851, is also compound, and contains peculiarities of a marked and ingenious description. It weighs 660 grains, carries 70 grains of powder, to propel a projectile, expanding by plug, weighing 480 grains. The cartridge case, which weighs only 105 grains, with the exception of the usual copper primer and papier-maché wad, is brass, and composed of six pieces, viz., the percussion cap, anvil, cap-chamber, base of shell, wad, and body. The latter is composed of a little over one fold of excessively slight and tough metal, which being united by solder, renders the case perfectly gas and water-tight, dispensing altogether with paper or linen wrapping. The shortness combined with a slight shrinking of this case when relieved from gas pressure and extreme heat after discharge, renders the extraction of the shell most certain and easy. I will only add in proof of the perfect expansion of Mr. Daw's cartridge, that when using it with an indifferently chambered Wantzel arm some time ago, I saw, on a freely extracted shell, the model of a flaw in the breech chamber of the arm, as if taken with wax.

The foregoing metallic cartridges, require in the arms with which they are used, extra mechanism for the retraction of the metallic shell.

The *fourth* is peculiar in breech-loading ammunition, not only as a clever contrivance to suit a particular arm, and a departure from the principle and fashion of other cartridges with punched or folded metallic cases, but as calculated to simplify the construction, and consequently cheapen the manufacture of arms for its use. It is a special cartridge (see Plate), the invention of Captain Selwyn, R.N., to be used

with a breech-loader, also his invention, and is an exception to all other ammunition I have seen, in the form of its casing, and the means employed for extracting the shell after firing. The one ingeniously reproduces in a cartridge, the principle, indicated in the well-known and once-prized patent breech, of igniting the powder charge as nearly as possible at the apex of a conical shaped chamber; the other renders unnecessary in the weapon using it, springs or other pieces of mechanism for extracting the shell, which in this case is removed from the barrel after discharge by simply opening the breech block, and slightly canting the arm: moreover, by converting this block into a patent breech, additional length of rifled bore is obtained without increased length or weight of barrel. The case of stamped or drawn brass or copper is in form spheroido-conical, the cone being slightly truncated by returning or cutting off a small portion of the apex. Here the cap-chamber, containing the percussion cap and anvil is inserted, being secured by a wad pressed or choked inside. When charged with 75 grains of powder, and a projectile of 480 grains, either for half-inch or regulation calibre, the cartridge is complete.

To load the arm, the cartridge is placed in the breech block, which opens over on the barrel, as in the Mont Storm, and is chambered to receive three parts of the length of casing. On returning the block to its seat, the projectile and that portion of the cartridge shell holding it, is inserted into the breech end of the barrel, round which there is a groove or depression into which the shell is expanded by the explosion of the powder charge and resistance to initial motion offered by the projectile, thus sealing the breech against gas escape, and compelling its extraction from the breech-chamber, as well as release from the barrel by the act of throwing open the block.

The length of this cartridge is two and a half inches. The total weight 670 grains. The cartridge is ignited by a blow transmitted through the bolt, which secures the breech block.

The *fifth* description is an American modification of the metallic-cased rim-igniting cartridge, converting it to central fire in two different ways; in the one (see Plate), by the insertion in the case of a triforked anvil, the flank prongs of which being fixed in the rim, secure the anvil in the shell, the centre prong (which is inserted in the percussion cap, placed on the surface at the base) serving to ignite the fulminate: in the other by the insertion inside the shell of a metal bar across the base, which is held in its place by pinching the case at the rim into shallow grooves in the ends of it, fulminate in the form of paste, or folded in paper, having previously been deposited on the surface of the shell beneath the centre of the bar or anvil, which is slightly concave in the middle to prevent contact with the fulminate by accidental concussion, or otherwise than by indentation from the outside of the surface of the case by a blow from the striker. This latter is known in the United States as the Modified National Cartridge. The total weight of the former cartridge is 650 grains, carrying 70 grains of powder to propel 480 grains of lead, the projectile for ·45 calibre being coated over with compound lubricant. The length is 3 inches. The total weight of cartridge, and weight of powder charge and pro-

jectile being the same in the latter for ·50 calibre. The length being 2 inches and thirty-one hundredths.

The *sixth* is the brass-cased cartridge (see Plate), invented by Colonel Berdan, of the United States Army, the well-known organizer and commander of the corps known during the civil war in America as Berdan's Sharpshooters. As before stated, the right to manufacture this cartridge in Europe, has lately been purchased by the Russian Government,* and I selected it from others, also of much merit, in consequence of some interesting experiments connected with it, which have lately taken place in the United States, before the Russian Commission, of which Colonel Gorloff, of the Russian Ordnance Department was President, and also of the information emanating from these experiments with reference to the relative weight of powder and projectile for certain calibres. Determining as a first condition, the weight of firelock the soldier can carry without detriment to his efficiency, to be about 9 lbs. 4 oz. exclusive of bayonet, 10,000 rounds of this ammunition were fired from the Berdan arm of this weight in a series of experiments daily, extending over a week. One of the chief objects of the trial was to ascertain the relative weight of powder and projectile made up in cartridges, giving the flattest average of trajectory at ranges within 750 yards, and consequently the longest dangerous distances or spaces, the term given in the American service to what is known in our school as the first infantry catch and graze of the trajectory.

From a barrel of 3 feet in length, of ·45-inch calibre, rifled with six shallow grooves equal the lands in width, having one turn in 2 feet, the following results were obtained.

The Berdan central primed cartridge, with 77 grains of powder, propelled 415 grains of slugged lead, with the initial velocity of 1,600 feet per second, trajectory 5½ inches in 200 paces; dangerous space, 400 paces; elevation, 10 minutes, 200 paces; mean deviation, $2\frac{2}{10}$ inch; 200 consecutive shots, 200 paces, the range up to 200 paces being protected from the influence of side wind.

For the above information I am indebted to the treasurer of the Union Metallic Cartridge Company, Bridgeport, Connecticut, who assisted in conducting these experiments. The total weight of this cartridge is 685 grains. The case is composed of three pieces, viz., the drawn or stamped shell; the re-inforcing ring or saucer, which guards against gas leakage through the base, and the percussion cap, all of brass. In the centre of the head of the case is a cavity, of size sufficient to contain a little cone-shaped anvil, which is drawn up from the metal itself at the bottom of this cavity. It is counter sunk, so far that a little basin-shaped percussion cap on being driven in, wedges fast, flush, or level with the base. The cartridge-case can be reloaded repeatedly, the exploded cap shell being picked off, a fresh one put on, and after inserting the powder charge, a bullet set in with a small

* It had been previously commended by the New York Board on Arms, Ammunition, &c., of which General Palmer, Commissary General of Ordnance, was President, as possessing peculiar merits.—J. O. H.

it will vary. We have abandoned the bell cup and anvil; therefore, it is not necessary to calculate for that. Now, for a second I will amuse you with an American story before I begin; it will illustrate very strongly the point which has been brought before us. An American in my presence was speaking of the new gun which the Emperor of the French has had brought to his notice, which will fire I do not know how many shots a minute, and requires only two men to attend to it. The American's remark was very pertinent indeed to the whole subject: "I want to know who is going to carry the lead." You can easily see that my object in this instance has been to show you that the weight of the projectile can be advantageously diminished, for, even admitting that the cartridge case is absent in the last case, you cannot make much change in the powder charge; but you can make a very notable change, as Colonel Boxer has shown us, in the weight of the bullet. Then you have the enormous value to the breech-loading gun, which is supposed to fire 20 shots in a minute, of the 320 grain bullet, giving 390 grains with the powder. Everybody knows that reserves can be brought up, and are brought up; but everybody knows that reserves, I mean reserves of ammunition, are not always in the right place when wanted. I have to recognise most gratefully the very kind notice which Captain O'Hea has been pleased to take of my gun and cartridge, which some of those present will appreciate or depreciate for themselves. All I have to say is, that the only cause why the gun was not brought forward at Woolwich, and for which I have a certificate, was that the cartridges were made too short, and they failed of their effect. The workmen beat up the gauge to conceal a defect in the workmanship. I have fired hundreds of rounds with it, and I say it is the true weapon for the soldier or sailor, on the score of simplicity, and of not being liable to derangement. I would draw your attention to this—that the Americans, however much they may have been behind us in some questions, are yet attacking the question from a scientific point of view. They do not make the mistake of first looking at a number of breech-loading guns, seeing how pretty they are, how well got up they are, what they weigh, and what they do not weigh. But they go straight at the projectile and its trajectory; for, as Captain O'Hea has very truly remarked, the projectile is *the* whole basis of the question. If you cannot tell what weight of projectile, or what form of projectile you are going to fire, it is utterly impossible for me to tell you what powder charge you shall fire it with; consequently, out of what arm you shall fire it. Projectiles vary so enormously that in the same gun I will engage you shall not get the same shooting with two bullets out of a hundred. Mr. Whitworth found that by elongating an ordinary Enfield bullet and increasing its weight the accuracy was brought up to that of the small bore. Mr. Macintosh, and those who have proposed his tubular projectile, found—and this is utterly independent of testimony from Mr. Macintosh himself—that, with the smooth-bore musket, the elevation of the sight, necessary to carry a bullet from the ordinary Enfield rifle 900 yards, was sufficient to carry with increased accuracy the tubular projectile 2,000 yards. That is the result of following a true scientific principle. Where you can reduce the resistance of the atmosphere, you achieve much more than by anything you can do in the barrel of the gun; for while the barrel of the gun acts only during the fraction of the second in which the bullet is passing along the 30 or 40 inches of its length, the atmosphere is acting throughout the whole flight. If you can abstract resistance from the front, or can diminish the vacuum behind, it is clear that the trajectory of the projectile must be flatter; that the causes of disturbance will be less; and that, if properly brought forward and closely experimented upon, it is calculated to effect a revolution in our ideas; not alone respecting the different descriptions of fire-arms, but respecting that old and much vexed question whether it is necessary to rifle barrels at all either in large guns or in small arms. We have long ago known that for all possible purposes, whether of sport or war, it is necessary to suit the projectile to the object, and not to change the arm because you want to attain a special object. A special projectile has this great value, that it does the work for which it is meant, out of a gun which is equally capable of doing any other special work when it is required. With regard to those systems which have been noticed this evening, in which india-rubber is adopted as a means of preventing the escape of gas, I have only to say

containing acids; and fouling or leading of the barrel, when proper lubricant is not used.

The *bullet cartridge* is represented here to-night by the invention of Mr. Mackintosh. It has been already ably noticed in a paper read by Captain Selwyn, R.N., at this Institution, on the 21st January, 1867, and its merits fully explained by the inventor, in the discussion which followed. It weighs about 600 grains.

I now turn to the projectile which, although, the last portion of the cartridge to be noticed, is by no means the least, if it is not the most important, of its component parts.

The fashioning, balancing, and weighting of missiles, with reference to the power to propel and purpose for use, have at all times, and with all people using warlike weapons other than fire-arms, been objects of particular care and study; so the form, weighting, with reference to propelling force (the powder charge) and correct placing of centre of gravity with regard to figure at least, as correctly as it may be possible to place it in a projectile of soft metal, ought to be primary objects of investigation now as heretofore.

Indeed, it is the conviction of those whose ability and practical knowledge of the subject make such opinion unquestionable, that until these points in the projectile have been thoroughly investigated and definitely settled for the arm of defined weight and calibre, it is waste of time, money, and skill, testing machinery, no matter how ingeniously contrived, for rapid breech-loading and repeating fire.

The principles which Captain Norton and General Jacob so zealously advocated, still hold good, and must now be acknowledged correct by all who study the subject of small-arms ammunition.

The projectile, like the cartridge, may be classified under the heads of simple and compound, both as regards form and component materials—the one in figure or substance being simple, the other compound.

Under the first head come spherical, conical or picket, cylindrical, and tubular, the last being the only form of this class calling for remark. Under the last, come the ogive and cylindro-conoidal, the latter best known, most highly favoured, and of all forms most generally adopted in its few varieties of length of cylinder to length of projectile, and figure of cone. To this form of projectile, being the earlier invented, and the most generally used, I shall first ask your attention.

To Major-General Boileau (whose scientific knowledge and practical experience make him a most reliable authority) I am much indebted for information regarding this form of projectile. He is of opinion that the cylindro-conoidal form is the best for all calibres of rifled small-arms, a small length of the cylinder only being necessary to hold a leaden projectile in the rifling, increased length of cylinder in the bullet requiring increased pitch of rifling in the barrel to steady its after-flight; but under any circumstances, the proportion of length to diameter uniformly diminishes as calibres increase.

In the larger calibres, it becomes necessary to have fore and base cavities, for the purpose of retaining length of projectile without extra weight, these calibres containing wood, baked clay, or other compara-

for the change, which has offered itself to my mind is that which is connected with the resistance offered by the air to the projectile. The resistance is known to vary, as the surface of the right section of the bullet, or, in any other terms, to vary, as the square of the diameter of the bullet, directly, and inversely as the weight. The new Enfield rifle, when converted into a breech-loader, was charged with a bullet of 480 grains, and very good practice was made with it. Here are some bullets for the Enfield rifle, they are made by myself, but they are very nearly the same as the Boxer bullet. If we take, then, the proportions of the squares of the diameters of different rifles, take, for instance, the Enfield rifle as ·577, and the rifle which is presumed to be adopted, i.e., the half-inch or small-bore as ·500, we find that, adopting 480 grains as the standard for the Enfield rifle, 360 grains comes out as the proportion for the half-inch, and that is within 5 grains of the weight that Colonel Boxer has adopted, so that the half-inch cartridge with a 365 grain bullet would produce the same effects, under the same circumstances, as the old Enfield bullet would produce with a 480 grain bullet. This appears to me quite a sufficient justification for its use, provided that after experiment it is found to have the same powers of penetration, and the same powers of retention of form, as the old Enfield bullet has. The lead appears to me to be rather soft, and I would suggest that in the bullets of the future a hardening material, either an alloy of lead and tin, or lead and antimony, should be used.

The CHAIRMAN: What is the diameter of the bullet?

Major-General BOILEAU: The diameter of this bullet of Colonel Boxer's is 0·495, that is, it is $\frac{1}{200}$ of an inch less than the calibre of the gun itself. But as before leaving the gun the bullet is supposed to be set up in the rifling, so as to fill up the bore, I have taken the bore of the rifles instead of the diameters of the bullets in making the comparison. The length of the bullet is 1·08 inches, that is, it is rather more than twice its diameter. I have no doubt that before adopting it, experiments were made, and that this is the result of the trial. The bullet appears to be solid enough. From a section, of which we have a specimen in the Museum, I find that there is a fore cavity as well as a base cavity. The original bullet was made with a longer base cavity, which is not a good form. I have experimented largely with bullets having a long base cavity, and they were some of the worst that I have ever tried. They look very well, but they are positively worthless; when fired from the rifle we did not know where they went, they seemed to split all to pieces. For a good practical reason the original form of the bullet has been altered. There is a diaphragm of lead in this second pattern, and there is a very long base cavity, $\frac{6}{10}$ of an inch in length, into which a clay peg is inserted. There is also a fore cavity in front of the bullet, it is covered over with a film of lead, though it appears to be solid. This improved bullet is, therefore, a deceitful fellow, for in striking, the front film would be broken down, and the head of the bullet would spread out, adding greatly to its damaging effect, which I look upon as an important change; if the bullet will hold its form, and it is found on experiment to succeed, I consider that to be a very great step gained. With regard to the powder charge, of course if the same charge of powder, 70 grains, is used with the 360 grain bullet, as was used with the 480 grain bullet, it will give the additional advantage of greater velocity. I must say that I look forward with much interest, but not without some misgiving, as to the success of this bullet. With regard to the cartridge case, without wishing to make any comparisons, my own predilection is in favour of a very thin metallic case, but not the coil case. My experience on testing that description of case is, that it is perfect; this one, a brass foil round case, which has been fired, has come out of the rifle as smooth as a piece of glass. I cannot say that I have found it practicable to reload them, but I have never had one misfire, neither have I seen one of them break. With reference to the question of fracture and danger from the splitting of the cases, I observe in the report which Captain O'Hea was kind enough to lend me, that in some experiments lately made in Albany, New York State, they split the cartridge case nearly from end to end before firing, and in some cases they filed the head almost off, but neither in one case nor the other was the shooting at all impaired, nor was there any escape of gas from the breech; therefore, I think we are taking more pains than is necessary in the

construction of our cartridge cases. If they are made water-tight, and sufficiently strong at the breech to prevent the escape of gas, that appears to me to be all that is necessary, and we shall be able to have a cartridge as good as we require at a moderate expense. Other speakers are, no doubt, anxious to address the meeting, but I am desirous of laying before you the result of my experiments with bullets in the half-inch small bore breech-loading rifle. The Boxer half-inch cartridge promises very well, and we need not be afraid of being behind other countries whenever the tug of war may come.

Mr. DAW: Captain O'Hea has been kind enough to bring forward a cartridge bearing my name. He puts it in order as second to the Boxer cartridge. Although I am interested in all that Captain O'Hea has laid before us to-night, and I may say it is interesting to all who study cartridges, I must say that I claim priority to Colonel Boxer; I made these cartridges upon which his cartridge is based four years or more before he attempted it.

The CHAIRMAN: We have nothing here to do with priority of invention.

Mr. DAW: With regard to lightness I would say that the cartridge shown here to-night, I have no hesitation in saying, can be made by the Government very much cheaper than their present one. That is a very important matter. The $2\frac{1}{4}$ coil, which Colonel Boxer's was at the time I sent in my cartridges for competition, was found to have certain defects, and now, that he has copied mine of $1\frac{1}{4}$, it is found to work better. I was the first to produce a $1\frac{1}{4}$ coil, and whatever claim is made for the Boxer I say it is based upon my principle, which was patented before he made the $1\frac{1}{4}$ coil. With regard to the bullet which General Boileau has alluded to, I can bear testimony to the excellence of the bullets he has prepared with greased paper wrappers. I have been abroad and travelled through Europe, and have witnessed different experiments by different Governments, and I can say that the bullets that were made with a greased-paper wrapper were excellent, and that they surpassed any bullets that came into competition with them, they gave a lower trajectory. I am sure when the question of bullets is gone into, the greased-paper wrapped bullet will be found better than the bullet with lubrication.

Captain JASPER SELWYN, R.N.: This is a subject in which I have taken much interest, I will, therefore, take a piece of chalk and illustrate what I have to say on the black board. I represent the cartridge case by C, the bullet by B, and the powder by P. I like to assume the extreme weight of the cartridge case rather than the lowest weight, for I have found that the cartridge case is quite up to 120 grains, therefore I put in all cases the cartridge case at 120 grains. I put the bullet at its varying weights of 530, 480, 320 grains; then for the tubular bullet I take off the cartridge case altogether, and put the bullet at 520 grains. Next I put the powder in all cases at 70 grains:—

C	120	120	120	
B	530	480	320	520
P	70	70	70	70
	720	670	510	590

Then 720 grains will be the weight of the first cartridge, 670 grains the weight of the second, 510 grains the weight of the third, and 590 grains the weight of the fourth. I will now put the bullet and powder alone, supposing we can do away with the cartridge case:—

B	530	480	320	520
P	70	70	70	70
	600	550	390	590

The first would weigh 600 grains, the second 550 grains, the third 390 grains, the fourth 590 grains. With the first I should get 70 cartridges, supposing my ammunition to be equal to 6 lbs.; the second would give me 76 cartridges; the third 108 cartridges; and the fourth I have not taken out—you can easily see how

it will vary. We have abandoned the bell cup and anvil; therefore, it is not necessary to calculate for that. Now, for a second I will amuse you with an American story before I begin; it will illustrate very strongly the point which has been brought before us. An American in my presence was speaking of the new gun which the Emperor of the French has had brought to his notice, which will fire I do not know how many shots a minute, and requires only two men to attend to it. The American's remark was very pertinent indeed to the whole subject: "I want to know who is going to carry the lead." You can easily see that my object in this instance has been to show you that the weight of the projectile can be advantageously diminished, for, even admitting that the cartridge case is absent in the last case, you cannot make much change in the powder charge; but you can make a very notable change, as Colonel Boxer has shown us, in the weight of the bullet. Then you have the enormous value to the breech-loading gun, which is supposed to fire 20 shots in a minute, of the 320 grain bullet, giving 390 grains with the powder. Everybody knows that reserves can be brought up, and are brought up; but everybody knows that reserves, I mean reserves of ammunition, are not always in the right place when wanted. I have to recognize most gratefully the very kind notice which Captain O'Hea has been pleased to take of my gun and cartridge, which some of those present will appreciate or depreciate for themselves. All I have to say is, that the only cause why the gun was not brought forward at Woolwich, and for which I have a certificate, was that the cartridges were made too short, and they failed of their effect. The workmen beat up the gauge to conceal a defect in the workmanship. I have fired hundreds of rounds with it, and I say it is the true weapon for the soldier or sailor, on the score of simplicity, and of not being liable to derangement. I would draw your attention to this—that the Americans, however much they may have been behind us in some questions, are yet attacking the question from a scientific point of view. They do not make the mistake of first looking at a number of breech-loading guns, seeing how pretty they are, how well got up they are, what they weigh, and what they do not weigh. But they go straight at the projectile and its trajectory; for, as Captain O'Hea has very truly remarked, the projectile is *the* whole basis of the question. If you cannot tell what weight of projectile, or what form of projectile you are going to fire, it is utterly impossible for me to tell you what powder charge you shall fire it with; consequently, out of what arm you shall fire it. Projectiles vary so enormously that in the same gun I will engage you shall not get the same shooting with two bullets out of a hundred. Mr. Whitworth found that by elongating an ordinary Enfield bullet and increasing its weight the accuracy was brought up to that of the small bore. Mr. Macintosh, and those who have proposed his tubular projectile, found—and this is utterly independent of testimony from Mr. Macintosh himself—that, with the smooth-bore musket, the elevation of the sight, necessary to carry a bullet from the ordinary Enfield rifle 900 yards, was sufficient to carry with increased accuracy the tubular projectile 2,000 yards. That is the result of following a true scientific principle. Where you can reduce the resistance of the atmosphere, you achieve much more than by anything you can do in the barrel of the gun; for while the barrel of the gun acts only during the fraction of the second in which the bullet is passing along the 30 or 40 inches of its length, the atmosphere is acting throughout the whole flight. If you can abstract resistance from the front, or can diminish the vacuum behind, it is clear that the trajectory of the projectile must be flatter; that the causes of disturbance will be less; and that, if properly brought forward and closely experimented upon, it is calculated to effect a revolution in our ideas; not alone respecting the different descriptions of fire-arms, but respecting that old and much vexed question whether it is necessary to rifle barrels at all either in large guns or in small arms. We have long ago known that for all possible purposes, whether of sport or war, it is necessary to suit the projectile to the object, and not to change the arm because you want to attain a special object. A special projectile has this great value, that it does the work for which it is meant, out of a gun which is equally capable of doing any other special work when it is required. With regard to those systems which have been noticed this evening, in which india-rubber is adopted as a means of preventing the escape of gas, I have only to say

that, in consequence of several and long-continued telegraphic researches, I have been led to make experiments upon india-rubber and vulcanite. I found that vulcanized rubber, which is the most lasting form, decays invariably in the course of a very few years. We may see that always in our ordinary india-rubber bands for letters; by the oxidization of the sulphur which is used to cure it, the india-rubber becomes rotten. Therefore, india-rubber is not a reliable thing to be stored up in magazines. You may find vulcanized india-rubber which may give you good results as a gas closure in England, for a space extending over a few months, but which will give you very unreliable and bad results after it has been stored in India for a year, or less than that. Therefore, I eschew *in limine* all substances which are liable to quick decay. I do not say that all substances are not liable to slow decay. The tubular system which has been adverted to by Captain O'Hea is not a recent invention. He has been a little mistaken there. It has slept in consequence of the doubts and pre-occupations of its inventor. It has been some twelve years before the public. When I tried to get it experimented upon by the higher authorities, I was answered that so many systems had been tried that this was not worth trying. I think that is scarcely an argument, and I hope still to see the thing carried out. The advantage of the tubular bullet is even more than that to which I have referred. We know now that in all breech-loading guns we must have some form of metallic cartridge (leaving out those india-rubber wads of which I have been speaking), in order to ensure sufficient gas closure. The tubular bullet is, or may be, made a metallic cartridge. When that is the case it is closed by a wad behind. I think it would be worth while to illustrate this to the meeting, for perhaps they may not have understood from the bullet alone exactly the way in which it is proposed to employ it. I will draw a section of a tubular bullet, pure and simple, without the rifling inside, as you see it has a wad behind. This wad has some arrangement for fulminate, either in the ordinary anvil and cup way, or in some other way, behind it. When the bullet is fired the air rushes into it, drives off the wad as it leaves the gun, and thereafter the bullet threads itself on a column of air, and passes through it, not only with lessened resistance in front, due to its tubular form, but with lessened vacuum behind, due to the passage of the air through it. Whereas, if I draw a section of precisely the same bullet, with a flat head, I should get this. The air passing off from the front and over the sides of the flat front re-unites again, but leaves in the rear a vacuum which is called the point of non-pressure, and which is equal to an added resistance in front. This is absent in the tubular bullet, and leads to an explanation of the fact of the lessened trajectory and increased range. I should also have the full resisting area in front.

The tubular bullet, charged with powder, becomes a metallic cartridge. The operation of firing them is this: a bullet is taken out of the pouch, and the powder is shaken out, and thrown away. It is then pushed into the breech-loader. A second bullet, with the powder in, and with the wad, of course, behind, as well as in the first, is then pushed in. The explosion in the second bullet leads to the expulsion of the first bullet. That second bullet is then pushed forward, and is changed from being a cartridge to becoming a projectile; it is then expelled in its turn. The weight of this 120 grain cartridge case, or we will take it as low as Captain O'Hea has put it, at 106 grains, is a very important element, when you come to deal with a number of cartridges. This element of weight would be absent were it possible to do away with those cases. The tubular cartridge also carries out the views of those who have expressed themselves very strongly throughout the whole question, viz., that the grand idea of a gun firing a cartridge loaded at the breech should be to expel that cartridge altogether. It has all the advantages of a metal cartridge, and leaves no more in the barrel after firing than a perfectly burnt paper cartridge would do. The expense of manufacture also is another item, which, I think, may be remarkably reduced. It is a question, no doubt, of a new manufacture; but we all know perfectly well that in the outset of a manufacture, conditions are present which are very speedily eliminated by those who engage in that manufacture, and who study the reduction of the pence that go to make up the pounds. Fouling also is a subject for very extended experiments. I have found it in the same gun, with the same powder, and the same bullets, to be the result of differences in the

metric pressure and the state of the atmosphere generally. It is a subject not rstood, I believe, at the present time; yet it points to the conclusion that it is ctly futile to fire any number of guns to ascertain the causes of fouling, unless do that under the same conditions of weather, and also under the same conns of time. Therefore, I should like to eliminate that as an error which would rb any philosophical conclusion on the subject. Let it be understood that are barometric and atmospheric disturbances which do interfere with that lusion. The question of bullets, which has been so ably brought forward by ral Boileau, I would only further advert to by saying that, in my own expee, I have found invariably that the so-called plug behind falls out before the t has attained its distance. I have fired at a long range of 2,000 yards against lk hill, which is lightly covered with earth, so that I recover all my bullets ly in the same state in which I fire them. I find the bullets invariably spread and get deformed in proportion to their variation from the solid form; that solid form is the one in which you get the full development of the specific ty; that any departure from it invariably leads to lessened penetration and er trajectory. In fact, as we might have supposed, from the very fact that they oyed lead in our bullets, no metal of lesser specific gravity suffices us. It d be unwise, for the sake of an accuracy, which may certainly have its value at range to Volunteers, but which has a very small value indeed to military men, ngage in a form of bullet which, though it gives us increased accuracy, inbly gives us lessened penetration and a higher trajectory. And I should not mand advocating the form of the tubular bullet unless, combined with the nn of air passing through the bullet, there was that lower trajectory and that ased penetration, which is the natural result of a higher velocity.

r. James D. Dougall: Mr. Chairman and Gentlemen,—The subject of the r and the remarks since have applied almost entirely to the shape of the idge and the weight of the projectile. Very little, indeed, has been said upon ature, the quality, or the explosive force of the powder by which the expulof the projectile is to be gained. When I was invited to attend this meeting, lly did not know what the subject of the paper to be read was; therefore, remarks I have to make, I beg you will bear with, as they are entirely pore; but I think you will find that they bear upon this subject. Before g one word upon the gunpowder, I have great pleasure in testifying to the ctness of Mr. Macintosh's system of tubular projectiles. I have been experiing upon it for some considerable time for sporting purposes; and I ely agree with Captain Selwyn as to the increased velocity and the conntly lower trajectory it obtains. The breech-loading system has reached nt which not only demands the greatest possible investigation into the best and weight of the cartridge and projectile, but also into the nature of the ler. The position that I am prepared to maintain is this, that an entirely ent gunpowder must be found; not what is commonly called black gunpowder, powder as nearly as possible possessing the same qualities as black gunpowder, wanting its faults, and as nearly approaching the qualities of gun-cotton also, wanting its faults; in fact, the *juste milieu* must be found. I am prepared to my belief that it has been found; found by the invention of Captain Schultze, e Prussian Artillery, perhaps one of the most distinguished practical chemists fficers of Europe, who I am proud to say is in this room. Captain Schultze's powmay be said to be almost entirely common gunpowder, with this great difference, his wood is not charred. The gases which are thrown off in the retort used for ing the wood, he prudently saves, and burns them in the gun itself, where I say ought to be burned. Instead of being thrown away they are reserved; the quence is, an immensely increased amount of projectile force, less rending , less fouling, and greater regularity in shooting. In the month of October, , my attention was first drawn to this powder. I investigated it very closely, shot a good deal with it. I also went over to Potsdam, and spent many there with Captain Schultze, investigating its chemical qualities; and I ned with the perfect conviction that this powder must take the place of all other lers. Since then, it has been introduced into this country, but unhappily not

under circumstances likely to bring it favourably before the public notice. But its position on the Continent is now this: it is being gone into on an immense scale at Spandau, by the Prussian Government, and every week there is a record made of the results. In Belgium it has not been taken up by the Government; but it is being taken up by a capitalist, Baron Van Aacken, who after a thorough investigation, is about to embark in a large way in its manufacture. In France, experiments have been carried on during the months of December, January, and February, at Vincennes. The result of these scientific experiments at Vincennes, is a report signed unanimously by a commission of officers, all recommending its use for the Chassepot; and the French Government are about to institute a series of experiments on an immense scale at Cherbourg.* The quality in which this powder surpasses gun-cotton is that it is under perfect control, while gun-cotton, if it has no other faults, is ungovernable.

The CHAIRMAN: The only difference is that the wood is not charred?

Mr. DOUGALL: The only practical difference. While gun-cotton is a vegetable substance prepared with acids, this is merely washed with acids. It is cleansed with lime, washed with acids, for a certain reason, and then, finally treated with the saltpetre itself.

General BOILEAU: What is its specific gravity as compared with black gunpowder?

Mr. DOUGALL: About one-half, as nearly as possible. The charge of the Chassepot rifle with the black powder is 5½ French grains; with this it is 2¾ grains, exactly one-half the weight of powder. The projectile force, I should say, is something in the proportion of 45 to 31, *i.e.*, using only one-half the weight of the new powder.

Captain TUPPER: Is there any sulphur in the powder?

Mr. DOUGALL: Not a grain. Sulphuric and nitric acids are combined in the first instance to produce chemical action, and drive the nitric acid into the wood. Afterwards the sulphuric acid is entirely removed; there is not a trace of it left.

Lieut.-Colonel FLETCHER: What is the relative strength of this powder, as compared with ordinary gunpowder?

Mr. DOUGALL: The relative strength is much more than double. We use one-half the weight. [Mr. Dougall here showed a Chassepot cartridge loaded with the new powder.]

Lieut.-Col. FLETCHER: Is that the charge for the Chassepot rifle?

Mr. DOUGALL: That is the Chassepot charge, exactly as it is used at Vincennes.

Lieut.-Col. FLETCHER: But the charge for the Chassepot cannot be double the size?

Mr. DOUGALL: The new powder is double the bulk of black powder. We use one-half the weight, so the size of the cartridge remains the same.

Admiral Sir HENRY CODRINGTON: What is the effect of Schultze's powder upon the arm?

Mr. DOUGALL: The effect is extreme diminution of the rending force. That was ascertained in the last experiments made at Vincennes a fortnight ago, by an apparatus carefully made for the purpose. It was found to possess less rending force than any powder that had ever come before the French Government.

Sir HENRY CODRINGTON. And the chemical effect upon the metal?

Mr. DOUGALL: It is perfectly innocuous to the metal. The claims for the powder are, its greater regularity; its greater force; it does not cause recoil; and it does not foul. On one occasion at Spandau, on going into the question of fouling, they fired 460 shots without cleaning the gun. The superintending officer then said, that it was no use going any further.

Captain BURGESS: Was a breech-loading cartridge used?

Mr. DOUGALL: A breech-loading cartridge was used. Captain Schultze can correct me if I am wrong, in saying that there were 460 shots fired.

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* Mr. Dougall here gave a brief description of its manufacture, a full description of which will be found in a paper read on the 30th March, and published in this number of the *Journal*, page 127, *et seq.*—ED.

Captain Schultze: Yes, 460.

Lieut.-Col. Fletcher: With reference to its durability?

Mr. Dougall: Its hygrometric qualities are slightly greater than those of the black gunpowder, in the proportion of 2·80 to 2·20; but the effects are only one-half. This was tried by storing six casks of each powder in the dampest casemate that could be found at Spandau, after careful registry. After six months both powders were used again, at the same elevation of 1,200 feet. The black powder had increased its dampness in the proportion of 2·20, but its projectile power had diminished 8½ per cent.; the Schultze powder had increased its dampness at the rate of 2·80, but its shooting power had only fallen off 4¼ per cent., about one-half the other. The cause of that is the not having removed the hydrogen in the powder. The hydrogen in the Schultze is analogous to the gases in the powder; consequently, they are consentaneous in their action, more consentaneous than in the black powder. That is the solution of it, I believe. I have nothing more to say upon this great invention, except that I am prepared to answer any questions if any gentleman would wish to ask any.

General Sir Wm. Codrington: Am I to understand that neither sulphur nor saltpetre is used?

Mr. Dougall: That is a great point, that while the gun-cotton is treated with acids, the saltpetre is here in a solid substance, by the application of a powerful microscope, you will see it glittering.

Captain Selwyn: Is there any trace of sulphuric acid?

Mr. Dougall: Not a trace. This is prepared with nitric or sulphuric acid very weakly, but the sulphuric acid is entirely removed.

Captain Selwyn: It is hard to say why it is put there.

Mr. Dougall: It is put there for the chemical action. The sulphuric acid is used to produce a chemical action to drive in the acids, but the sulphur is entirely removed afterwards.

General Boileau: Does this powder give much smoke?

Mr. Dougall: Very little. It is somewhat curious that when the combustion of black powder takes place, of the gases evolved only 31 in the 100 are driving powers, and 69 are inert; while in this powder 90 in the 100 are driving gases, and only 10 are inert.

The Chairman: Would you ignite a small quantity of the powder?

Mr. Dougall: With pleasure; I will hold this cartridge in my hand between my fingers, and show that there will be no recoil. I will put the equivalent of three drachms of black powder. [Mr. Dougall here showed the experiment.] With the black powder you would see the flame, &c., spreading out like a mushroom; with Schultze's powder you see that the gases rush out consentaneously. With regard to cost it will be very much less than gunpowder. The process of manufacture may be under 72 hours. It is impossible there can ever be any accident to human life. The powder is all made in large tubs, by women.

Lieut.-Col. Fletcher: Has the uniformity of shooting with this powder been tested with rifles?

Mr. Dougall: Yes; this very day a party of military and scientific gentlemen tried it, and made a much flatter trajectory with it. If I were to cram in as much powder as I possibly could, we should get a lower trajectory still.

The Chairman: Have the Prussian Government adopted it?

Mr. Dougall: They are going on with experiments now that will last till next January, because, as I said just now, every week there is a fresh report. It has been perfectly successfully tested for small arms.

Captain Selwyn: May I suggest that Mr. Dougall should give us a detailed paper on the subject, because it is hardly doing justice to Captain O'Hea's paper to leave it undiscussed?

The Chairman: It would be very desirable.

[Before closing the subject Mr. Dougall ignited a small quantity of the powder on an earthen plate. After the ignition there was a small quantity of residuum left. This residuum, he explained, does not exist when the powder is fired in the gun; it is burnt, and goes off with the smoke. He mentioned that one of the Commissioners

superintending the experiments at Vincennes had himself recently brought out what he considered to be a very great improvement in gunpowder. Captain Schultze's powder could not by any possibility have met with a more dangerous rival. One of the improvements which this French General Officer claimed for his powder was the reduction of smoke. It was accordingly proposed to test the two powders in a room. Captain Schultze's was tested first. They fired 30 charges in the room without creating anything unpleasant. After 6 charges of the other powder the inventor begged that the experiment might be stopped, and he was one of those who, with the greatest pleasure possible, signed the unanimous certificate in favour of the superiority of Captain Schultze's powder.]

Mr. STIRLING LACON: The residuum on the plate looks like fouling.

Mr. DOUGALL: Yes, because combustion of the powder is not complete in the open air.

The CHAIRMAN: We have to some extent wandered from the subject which Captain O'Hea has introduced. Still the remarks have been interesting and valuable, and I think it is a subject that might be very usefully brought before this Institution. I am, however, anxious to bring back the discussion to the original subject. I do not know whether any other gentlemen wish to make remarks upon Captain O'Hea's paper before we conclude.

Lieutenant-Colonel FLETCHER: There are a few remarks which I should wish to make. It is a subject I do not wish now to go into, and there is very little to be added after Captain O'Hea's very valuable paper and Captain Selwyn's remarks. The only point that I should like to touch upon is regarding what Captain O'Hea said with reference to the Chassepot rifle. I think it must be satisfactory to us to know, that at present, with reference to the arms of our infantry, I believe we are superior to any other nation. I am not speaking of the future, or how other nations will be armed, but as far as regards the comparing our own arm, especially with the Chassepot, I think that we are in possession of a much more useful and more serviceable arm than foreign nations. Supposing we were called on for foreign service at once, I think we should have an advantage.

The CHAIRMAN: Perhaps Captain O'Hea would wish to make some remarks in reply.

Captain O'HEA: I only wish to ask Captain Selwyn a question with regard to the Macintosh tubular bullet. In all tubular bullets containing a charge of powder, the powder case expands on the explosion of the charge. It, therefore, fits the barrel excessively tight. Is there any difficulty in moving the tubular cartridge forward when you wish to make it a projectile? You have to push it forward to make it become a projectile for the next round. Is there any difficulty in that?

Captain SELWYN: I may answer that by saying that the ordinary requirements to which Captain O'Hea before adverted, although they apply principally to rifles, apply, in some degree, to smooth-bores, from which it is proposed to fire this projectile. For even in a smooth-bore you require some measure of elasticity between the bullet and the fire-arm. That is obtained in this instance by a wrapper, or envelope, which may be made of tough paper, but which I should prefer being made of something more nearly approaching to felt; very thin, still a felt containing a lubricating material. Under these circumstances the felt is subject to compression, but its elasticity enables the bullet to be pushed forward.

Captain O'HEA: I have only to express my thanks to General Boileau for reading my paper, and also to Captain Selwyn and other gentlemen for the remarks they have made.

The CHAIRMAN: I am sure that the meeting will thank you for having written the paper, and also General Boileau for having read it. It is a very valuable paper and also the remarks which have been made by General Boileau and by Captain Selwyn have been most valuable in illustrating this much vexed question, and one not yet completely settled.

Evening Meeting.

Monday, March 30th, 1868.

REAR-ADMIRAL SIR FREDERICK W. E. NICOLSON, Bart., C.B., Vice-President, in the Chair.

NAMES of MEMBERS who joined the Institution between the 16th and 30th of March.

ANNUAL.

Kerr, Henry, Capt. 7th Royal Fus. 1*l.*
Whitehead, F. G., Lt.-Col. 29th North Mid. Rifle Vols. 1*l.*
Moysey, C. J., Capt. R.E., 1*l.*
Cohen, Lionel B., Lieut. Tower Hamlets Eng. Vols. 1*l.*
Leith, James, V.C., Major, late 2nd Drgs., Hon. Corps Gent.-at-Arms. 1*l.*
Hales. Arthur, Lt. Cape Moun. Rif. 1*l.*
Kendall, William, Col. R.E. 1*l.*
Boxer, C. F. R., Capt. R.N. 1*l.*

SCHULTZE'S GRANULATED-WOOD GUNPOWDER.

By Mr. JAMES D. DOUGALL.

BEFORE entering upon the immediate subject of this paper, I crave your indulgence for a brief space to explain my position and connection with it. In October, 1865, I was waited upon by two gentlemen, both of whom, I believe, are now present, but who were at that time entire strangers to me, who showed me specimens of this new powder, of which I had not previously heard. Having, so far back, as in a work of mine published in 1858, but written in 1857, expressed an opinion, that we were on the eve of some great invention in explosives, I naturally gave the matter some attention, and, having since then seen no reason to alter the favourable opinion I formed of the powder in the first instance, my name has gradually become connected with its introduction into this country. But, my appearance before you this evening is not in the character of a partizan or a speculator. I have no money whatever embarked in the matter, and all I can lay claim to, is an honest and energetic resolution to satisfy my own mind in the first instance; and, in the second, if so satisfied, to give publicity to my convictions for the general good. For this purpose, I have experimented with it practically on a large scale with rifle and smooth-bore guns.

I have visited the manufactory or powder mills at Potsdam, and, I may say have exhausted the subject so far as it affects practical or sporting gunnery, by examination of the mode of manufacture, and, if I may be permitted the use of the term, by *cross-examination* of the talented inventor, Captain Edward Schultze; and, finally, by every practical test I can think of as necessary. I take this opportunity to pass a slight and most imperfect eulogium upon Captain Schultze, a man whom I consider it an honour to know, who, above all degree possesses the most remarkable combination of sense and sentiment I have ever known, and who meets every investigation of the merits of his invention in the frankest spirit. You will shortly be told how this sensitiveness of character bore directly on the invention now before us. I confess that I was not prepared for the remarkable knowledge he displayed of the theoretical nature of this powder—that is to say, that certain results I had practically arrived at for myself, but for the causes of which I could not account, were by him explained in figures, and to minute decimals of the most satisfactory and convincing character.

The history of the powder is as follows:—Captain Schultze, a considerable number of years ago occupied the same position at Spandau, as the talented Mr. Abel now does at Woolwich. At once an artillery officer and a chemist of the highest attainments, he was chief of the *fonderie*, but the Prussian Government's attention having been drawn to gun-cotton, to Captain Schultze was given the important task of solving the question—Is gun-cotton an available explosive for military purposes? He was therefore removed from the *fonderie* to the chief charge of the Gunpowder department. In that position, with every requirement at command, he for years experimented on gun-cotton, and at last gave in his final opinion against its adoption, describing its character in these emphatic words, "It possesses the *beau-ideal* of force, but is quite uncontrollable."

During these experimental years he was also engaged (in the exercise of his official duties) in the daily manufacture of black gunpowder, so that he was master of his subject from the two points of view bearing upon these great rivals, gunpowder and gun-cotton, when an accidental circumstance sent his energies in a fresh direction. A brother officer had been present at Mayence, on the Rhine, when the tremendous explosion of the powder magazine took place, which must be fresh in the recollection of many gentlemen now in this room. Captain Schultze had spent many happy days of his life in Mayence; I have already told you that he is a man possessing much sentiment in his nature, in a word, a man of both quick and deep feelings, and he was so horrified by the details of his friend's description of the effects of the explosion, that he then and there resolved to devote the remainder of his life to the discovery of a powder capable of being manufactured and stored without risk to life or limb. After years of labour and the trial and rejection of nearly every vegetable substance within his reach, he succeeded in the production of this granulated or raw uncharred wood powder, the subject of this paper, and which, after these preliminary remarks, I shall now proceed to describe.

Captain Schultze had, impartially and without prejudice, already arrived at the opinion of the worthlessness of gun-cotton as a trustworthy explosive. He had the most perfect confidence in the propulsive powers of black gunpowder. He did not, and he does not now, depreciate or disparage the merits of the latter, which for centuries has well done its work, and has been one of the chief agents in the promotion of civilization. He set himself to the task of modifying the nature of that black powder, adopting it as a standard of explosive qualities, but being resolved to remove what he considered its objections, and principally these—1. Danger in manufacture and storage; 2. Heating and fouling of the gun; 3. Undue recoil. Other minor matters I have no occasion at present to refer to.

Starting from the position that all explosives should be composed of a granulated substance, the thought at last struck our inventor, that he might attain his object by means of a powder as nearly approaching black gunpowder as might be, but with the wood uncharred, with little or no sulphur whatever, and above all, with the presence of saltpetre or its equivalent, in solid substance; in a word, an explosive occupying the *juste milieu* between the pyroxyline proper on the one hand, as *gun-cotton*, and black powder on the other. Still giving all due regard to the great merits of the latter, he chose those woods, as the alder, which give the best charcoal ingredient for black powder, at least for fire-arms, and he proceeded to granulate that wood in different sizes of grains, by which as in black powder, the rapidity of combustion is governed. But here, let me mention, *in limine*, that there exists a great difference in the conditions for the government of the rate of combustion, if indeed, with regard to the size of the grains, it be not in the inverse ratio to that of black powder. Hence grave errors have been, and to my knowledge, are now being made by experimentalists, who, however well versed in testing the shooting powers of black powder, have, without seeking advice or guidance from Captain Schultze or his agent, rashly experimented, in small bore rifles for instance, with his powder as made for quite other varieties of fire-arms. Equally deceptive and fallacious results would follow the use of fine-grained black powder where large-grained is required, or *vice versâ*. This caution is all the more necessary, that Captain Schultze is now making seven varieties of powder, and I believe that one or more of these has also sub-varieties.

Here, for a purpose, which will now explain itself, I must, with your permission, pause in reading this paper, to initiate one of the more practical purposes of the evening. I shall have occasion to observe that Schultze's powder may be wetted without caking, and be dried without diminution of its force. I shall now wet a small quantity of it in your presence. Ten per cent. of water, I may here mention, may thus be added to this powder without diminishing its force when re-dried, for this reason, that, with that amount of water, the salts are not dissolved. [Mr. Dougall here poured water upon a small quantity of the powder in a wine glass, and handed it to the serjeant in attendance to be dried.]

The wood about to be used is kept in water, so as to give it tough-

ness and adherence under the saw. By fine saws, which can be set so as to govern the size of the grains, the wood,—alder by preference, to which next ranks the *rhamnus* of the ancients, I am not certain of its popular name, if it be not "*buckthorn*,"—is cut into cross veneers. These veneers are again punched out into grains. The remaining part of the veneers, after passing through the punching-machine, is utilized by further processes. The main bulk of the wood, you will have an opportunity to observe, is cut into little solid blocks, their size being governed by the setting and thickness of the saw, and the size of the punches. Mere *débris*, or sawdust, a word which has been unhappily connected with this powder, does not at all suit the purpose. The grains must be, as I have described, cubes or rectangular parallelograms, and, by the kindness of my neighbours, Messrs. Murray and Heath,—gentlemen who are always willing to promote science for the sake of science, and not in the mere business sense,—you will have an opportunity of examining these grains through powerful microscopes. Some *débris* will of course be found to exist, its partial or complete removal being a question resolved by desired requirements. After the grains have been so produced, they are submitted to various processes for the removal of acids and other easily soluble substances, after which they are in a condition to receive the first impregnation of an explosive ingredient. Forty parts by weight of concentrated nitric acid 1·48—1·50 are mixed with 100 parts by weight of sulphuric acid (sp. gr. 1·84). This mixture is set aside in some cool place for use. To 100 parts by weight of this mixture are six parts by weight of the prepared grains gradually added, stirring the whole constantly for two or three hours, when this part of the operation is completed. The presence of sulphuric acid is required solely for the purpose of creating a chemical action, by which the nitric acid is driven into the wood. Part of that nitric acid forms a chemical combination with the wood, and remains fixed there. The other part, and the whole of the sulphuric acid are withdrawn from the wood by subsequent operations. I request your especial attention to this great fact, the withdrawal of the sulphur, for on it rests much of the excellence of the powder, and I do this with the greater confidence that, a doubt of this having been expressed by a gentleman of authority on fire-arms at your meeting on the 16th instant, I have pressed the question on Captain Schultze, on whose word I have the most perfect reliance, and he assures me that there is no appreciable TRACE EVEN of sulphuric acid left in his powder, and that his sole reason for mixing it with the nitric, is to drive the latter into the wood, or create a chemical action, by which the wood and the acid form a combination according to a well-recognized law in chemical science. Indeed I know, practically, that the sulphuric acid, so withdrawn, is again utilised, and that at first considerable loss was occasioned by it being allowed to escape.

The grains of wood, now combined chemically with a certain amount of nitric acid, are freed from the merely mechanically adhering remainder of the acids by a centrifugal machine or other process, are placed in cool, running water for a considerable number of hours, afterwards boiled in a weak solution of carbonate of soda, again placed in

running water, and finally are dried and stored, or immediately, if desirable, converted into the finished powder.

I shall now burn some of the grains in this incomplete state. You will observe that their inflammable qualities scarcely exceed those of dry sawdust. In this state they can be kept for any reasonable period, and even in a damp state for safety in shipment or storage.

The whole of the above processes being conducted in a wet state, there is absolutely no danger of explosion attending them. Those who have visited Potsdam must know that it is the pet place of the Royal family of Prussia, a town of palaces and churches, with beautiful environs. So strict are the police laws, that Captain Schultze is not permitted to fire a rocket there, even for the purposes of experiment, or to show to inquirers like myself the immense height to which he can drive that form of projectile with his powder. But, in this beautiful town, certainly not in its centre, but still within its precincts, on ground only divided by a low paling from his own garden, and with neighbours' houses on each side, is the powder manufacture carried on up to this stage. I had the curiosity to measure the nearest point (from the much more extensive factory than I was prepared to see) to Captain Schultze's residence, and found it exactly 45 feet. But I saw something still more unexpected, and that was, Captain Schultze's chief chemist smoking his cigar daily while occupied in his practical duties in a gunpowder manufactory. The grains in this stage are, at Potsdam, now conveyed to Captain Schultze's magazine, situated about two miles from the factory. They are there treated finally with nitrate of potash (saltpetre), or, what I believe Captain Schultze prefers for most varieties of his powder, nitrate of barytes. [Mr. Dougall here read from the Patent Specification the description of this process (page 5):—]

The powder is now complete, and being dried by exposure to a temperature ranging from 90 to 112 Fahrenheit, for a space of 12 to 18 hours, is now ready for use. Even now the danger of accident from explosion is not great. This was on one occasion somewhat sharply tested. Fifteen cwt. of powder in its perfect state was contained in a large iron vessel, having a horizontal flange. A merchant coming to purchase a quantity of the powder was taken, by an assistant, in the absence of Captain Schultze on military duty, to the magazine. A small quantity of the powder was placed on the flange, and ignited with a lucifer match, and both men withdrew immediately afterwards, leaving no apparent cause of mischief. The door was hardly shut and locked, however, when flames burst through the roof of the magazine, a rapid deflagration, but no actual explosion, followed, the copper pipes used for heating the drying-room were melted, but there was no concussion whatever. Although this misadventure cost Captain Schultze a considerable sum, I have heard him say that he never expended money with so much satisfaction, for it proved that his powder, so powerful in fire-arms or in blasting, when unconfined or loosely confined was comparatively harmless.

We have now arrived at the complete powder. This, I have already stated, is made in at least seven varieties, all differing in force as

required, thus proving that its manufacture is under scientific control, and not a merely fortuitous process.

I must here confess a reluctance to describe or dwell upon these various forces. I repeat that I do not treat the subject in the spirit of a partizan. I know the claims of our English gunpowder, its power, its regularity, and its general excellence. Where I am compelled to draw comparisons, it is where I have no other standard of excellence, no other power of illustration. I shall briefly, however, tell you what I have seen done with one variety of this powder. I have seen half an ounce of it only, enclosed in a small glass bottle, such as you may purchase dissolved gum-arabic in, sunk in two feet of water, throw a column of water, containing I know not how many gallons, to a height of 21 feet. Exactly the same quantity of black powder, fired in the same spot, in a similar bottle, hardly elevated the surface of the water, and only produced an ebullition. At my special request, although those present could not understand my purpose, 1¼ ounces were then sunk in 15 feet of water. The effect of the explosion was marvellous. I myself was standing at a distance of eight or ten yards from the margin of the river, when, without any noise being heard, I found a violent vibration under my feet, consisting of I should say, five distinct pulsations of the earth. Gentlemen, now in this room, standing at a much greater distance, described the vibration in equal terms. Vast quantities of mud, branches of trees, vegetable remains, and such other substances as may be looked for at the bottom of a river, came to the surface, and, finally, dozens of roach and other fish, in a stunned state mostly, only a few being apparently quite dead. I conclude from the large number of these fish, and their different degrees of suspended animation, that the shock must have extended over a large space of water. On the land the vibration must have extended over at least the space of an acre. This was, I remind you, all done with 1¼ ounces of Schultze's powder, as specially prepared for mining purposes, for coal or soft rock; other varieties, quite differing in effect, being prepared for blasting hard rock. What the power of such powder may be in a shell or torpedo, it is frightful to contemplate.

I have purposely, by way of dramatic contrast, described to you the effects of this terrible variety of powder, that what I am about to show you may be the more striking.

I have now in my hand a quantity of the regular sporting powder. You see how comparatively slowly it burns, how rapidly the gases ascend, and with what I may call harmony or consentaneousness they do ascend. All these qualities are elements of correctness of the explosion, for it is by them that Captain Schultze claims great reduction of recoil without any loss of propulsive force.

The exact qualities of the various gases evolved by the combustion of gunpowder or other explosions, I do not pretend to be able to discuss. But, as Captain Schultze has, in a pamphlet or pamphlets published in the German, French, and English languages, given publicity to not only the results of his own analyses, but to those of other distinguished continental chemists, I venture to express a hope that in the following statement I shall not be accused of any invidiousness or mis-

representation. Captain Schultze, then, asserts that, when we burn black gunpowder we evolve 31 per cent. of active and 69 per cent. of inert or even obstructive gases. He argues that these 69 volumes of gas, in the proportion of more than two to one, repel the onward or propulsive motion in a great degree, and cause an increase of recoil. He illustrates this assertion by the following simple experiments. [Mr. Dougall here burned the fill of an open Lefaucheux cartridge fastened to the end of a slender wire in a horizontal position. The wire never vibrated or bent; but when the same cartridge was *one-third* filled with black powder, the recoil was so great that the wire was bent forcibly downwards, and the cartridge was driven right under his hand, in which position it remained.]

He also asserts that a large part of the inert gases rapidly recondense, and so foul and heat the gun.

On this part of the question, I cannot speak authoritatively, much less dogmatically. Captain Schultze's theory is certainly largely borne out in practice, but, speaking impartially and dispassionately, I think that we can arrive, theoretically, at very little exact knowledge of the comparative powers of gases as evolved from explosives in a state of confinement, as in a gun. The expansion must be governed in a great degree by the degree of heat. That heat I should be inclined to term immeasurable. I, therefore, even were I competent to discuss the more intricate and chemical branches of my subject, must avoid such discussion. Were Captain Schultze himself present, I might take a different course, but he is now so closely engaged at Paris, with the French Ministers of War and Marine, and other officials, that he could not possibly attend this meeting, although both strongly urged and being himself desirous to be here.

Having stated his theory of the explosion of black powder, I now give that of his own. For *it*, he claims not less than 90 per cent. of active ordinary gases, and only 10 per cent. of inert! This difference, if borne out in practice, is literally astounding, for even with one half of the weight of charge, which is his professed equivalent, we have 45 driving powers, with 5 inert, against 31 driving powers, and 69 inert, in the charge of a firearm!

But I should be deficient in moral courage did I not acknowledge that experiments, startling as the statement may appear, largely bear out these assertions. Of one of these I shall now give the results, first stating that I shall not take up your time by giving exact fractions, but giving you sufficiently approximate returns. I constructed a target, running on wheels, upon a framework of iron. It is not a highly scientific target, in so far as it cannot register by measure or weight the exact force with which it is struck, but it must of necessity correctly measure comparative force. At this target, from the same breech-loader, were fired a large number of shots with gun-cotton, with gunpowder, and with Schultze's powder. I may dismiss gun-cotton at once by stating, to use a sporting phrase, it was "nowhere," and now I never think of taking it into consideration. The last experiment made was, as usual, with 82 grains = 3 drachms of black powder, and an equal bulk, something slightly over half the weight of Schultze's

powder. The charge of shot was $1\frac{1}{4}$ ounces of Walker, Parker, and Company's No. 6. I consider this a fair test, because we can arrive at some degree of accuracy in our summing up, whereas with a single ball, or measuring velocity by that most fallacious of all tests, penetration by a soft leaden bullet (I do not include, in this prevalent and mischievous fallacy, penetration by a projectile of any metal hard enough to retain its shape and not be flattened) no approach to comparative calculation can be attained. I can also, at such a test, bring into use my trained judgment as a practical gunsmith.

The result was as follows:—

Aggregate pellets of 6 shots.

Schultze powder	..	1150	Motion to target		..	$10\frac{1}{8}$ in.
Black powder..	..	1016	Do.	do.	..	$6\frac{4}{8}$ in.
		134				

Now the value of this experiment lies in this, that if we add the above 134 pellets to the 1016, aggregate of the black, being about $\frac{1}{10}$th of the aggregate of the Schultze pellets, we may extend the dislodgment of the target by the black powder also $\frac{1}{10}$th, say $\frac{5}{8}$ths of an inch, near enough for our purpose. This gives $7\frac{1}{8}$ inch motion against $10\frac{1}{8}$. Now, $7\frac{1}{8}$ inches are equivalent to $\frac{57}{8}$ths of an inch, and $10\frac{1}{8}$ inches to $\frac{81}{8}$ths. By the simple rule of three we find, then, that if 31, the driving powers of black powder, asserted so at least by Captain Schultze, give this $\frac{57}{8}$ths, his powder should, if it really possess 90 per cent. driving power, give $\frac{82}{8}$ths and a fraction, with one-half the weight = 45. We have found that it gave exactly 81, an approximation so remarkable, that we can hardly attribute it to chance. Gentlemen now present can testify to the impartial exactness with which this experiment was conducted.

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31 : 57 : 45 (being one-half of the 90 per cent.)
     45
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     285
    228
    ----
   )2565(82 23/31
    248
    ----
      85
      62
      --
      23
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From experiments with small shot we come to those with rifles. In this branch of practice I have confined myself to my speciality, sporting rifles. I am not now, and at no time have been, occupied with military rifles, but, using immense charges in my guns for heavy game, I naturally have anxiously and closely tested this new powder on my

own behoof, because, if I can find an explosive giving great velocity, with little recoil, and no smoke to speak of, I can put into the hands of my friends in India and elsewhere, weapons possessing great advantages where, as in the jungle, the pursuit of ferocious animals is attended with considerable personal danger. Independently of other considerations then, where life itself may be at stake, I am bound to be more than usually guarded in the recommendation of any new explosive. I now produce a sheet of iron, $\frac{3}{16}$ths of an inch thick, fired at from 100 yards distance, with one ounce spherical bullets of pure soft lead. You will be able to judge of the comparative velocity for yourselves. I may appear to contradict myself after what I said a short time ago, in thus appealing to penetration for a measure of velocity, but the penetration of a single sheet of iron as this is, without being backed up with other substances, whose reaction can be brought into play, is very different from the penetration of such a backed up substance, or from layers of substances in *contact* with each other. As a comparative measure of velocity, it is a fair and handy test.

The rifle used in this test was a 16 gauge Lockfast breech-loader. The charge of black powder was 4 drachms, about 109 grains, No. 6, that of Schultze powder being equal volume, or as near as may be one-half in weight, or 54 to 55 grains. The results are before you in this plate. I shall not pretend to claim a victory for either explosive. They have both done their work well, and so nearly on an equality, that it may be difficult to distinguish any appreciable difference. I think it proper to state that the Schultze powder used was sporting powder, not rifle. My reason for this was that I wished to try the shooting with such powder as would be likely to fall into a sportsman's hands. Whether or not a still greater velocity might have been obtained with Schultze's rifle powder, I am not prepared to state; but I understand that it is manufactured of greater strength than that of sporting powder.

In direct connection with rifle shooting, I am in a position to inform you that after prolonged trials at Vincennes, extending, with short intervals, over three months, the Committee of Officers appointed by the French Minister of War to superintend the experiments, although at first very dubious of the good qualities of the new explosive, and indeed prejudiced against it, through confounding it with some other powder, unanimously signed the report recommending its adoption in the French Army. The conditions were that it should excel the French gunpowder on six points, viz. :—

1. Absence of fouling.
2. Absence or diminution of smoke.
3. Diminution of recoil.
4. Reduction of heat, so as to permit more prolonged shooting with the Chassepot rifle, the weapon used for the trials.
5. Greater initial velocity and regularity of shooting.
6. Reduction in wrenching or bursting force.

On all these points Captain Schultze was successful, and the report was signed accordingly, as I have said.

In this country, a gentleman of high scientific attainments, a Fellow

of the Royal Society, and well qualified for the task, has experimented largely at 800 yards' range with this powder in the Snider and, possibly, other rifles. His experiments have been carefully and slowly conducted. They are not yet concluded, but they have hitherto given every promise of success.

In very elaborate experiments now being conducted at Spandau, the same success has hitherto attended Captain Schultze's invention. I may state here, *par parenthèse*, that although in Belgium the question has not been taken up by the Government, a well-known nobleman and capitalist of that country has arranged with Captain Schultze for the manufacture, and is about to erect extensive powder works.

The last, and in one sense the greatest, branch of this subject, so far as it treats of propulsive force, is the adaptability of this explosive to cannon. As an Artillery Officer, Captain Schultze is here quite at home. Indeed, it was his practice, when in service, to load one-half of his battery with black powder, and the other with his own. What he particularly claims, however, for this branch is the almost total absence of smoke, and great reduction of wrenching force and recoil. It must be known to you, Mr. Chairman, and to many other gentlemen in this meeting, that no heavy marine gun has yet been made by the French, capable of standing 45 rounds with full charges of English gunpowder. Consequently, the French are now in anxious search of a more suitable explosive, and that is the next task set to Captain Schultze. Immediately on his obtaining satisfactory results at Vincennes with small arms, he was handed over by the Minister of War to the Minister of Marine, and we shall shortly hear of what will have been done on an extended scale with heavy marine cannon at Cherbourg.

But the French are going still further. I beg that what I am now about to announce may be taken at its actual value. Hitherto I have stated Captain Schultze's claims from facts and experience. What I am now going to mention is hypothetical, and it is that several men of science in Paris, including the Emperor himself, believe that in this powder they have discovered what they have long sought for, a "*motor*," to take the place of steam in sea-going vessels. This is a most important matter; not in these days of scientific progress to be dismissed with a sneer as the dream of a visionary. I am quite aware of the danger of over-stating a case, but I beg of you to bear in mind that this is, at least, no dream of Captain Schultze. He has been shown the machines as already constructed, and has been told their requirements. The question has been put to him, can you give us an explosive fulfilling these requirements? His answer is, "I believe I can," and time must alone tell with what correctness this reply has been made, but I should consider him a man most unlikely to commit himself by a rash promise or on insufficient grounds. Failure in this case would be no argument whatever against the general value of his powder. I have referred to this sought-for *motor* principally to prove the great importance which Frenchmen of science attach to the capabilities of both Captain Schultze and his invention, without attaching any value to it whatever in connection with the more legitimate purpose of the latter.

If I have been rightly understood in this necessarily most incomplete and imperfect paper, the claims for Captain Schultze's invention principally rest on the following grounds :—

1st. Safety and rapidity of manufacture, and consequent reduction of cost. 2nd. Safety in transport and storage. 3rd. Less injury by absorption of damp, first, because the imbibed humidity, up to 3 per cent. is not injurious to its propulsive powers; and secondly, because, if even 10 per cent. of water be added, no mischief has accrued if the powder be re-dried. [Mr. Dougall here burned the powder, which he had previously saturated with water. It exploded, without the slightest apparent diminution of force.] 4th. Great diminution of recoil. 5th. Ample driving force. 6th. The power of almost indefinitely governing its rending force, so as on the one hand to adapt it for immense charges for cannon, or other fire-arms, without bursting; on the other hand, to increase that rending force up to the effect which I have faintly endeavoured to describe, as exemplified by explosion under water. 7th. Remarkable adaptability to breech-loading fire-arms for the most obvious of reasons, viz., absence of fouling. One of the tests at Spandau was to attempt to foul a Dreyse needle-gun by repeated firing, no difficult task, any one would say, who knows the construction of that weapon. But after 460 rounds, the gun remained clean, and the superintending officer then ordered the firing to cease. A somewhat similar result took place at Vincennes, with the Chassepot.

I have thus, Mr. Chairman, endeavoured to give perhaps in a somewhat desultory manner, a sketch of the history, manufacture, and present position of this new explosive. I trust that I have said enough to elicit discussion, and to engage your future attention to its qualities and career. I make no foolish or arrogant claims for it. To succeed, it has much work to do, many difficulties and prejudices to overcome. I shall therefore finish this paper by reading to you the several objections, raised some time ago, *in the most authoritative quarter*, and my replies, as taken from Captain Schultze's own lips, and immediately converted into plain English.

1st Objection. That the Schultze powder can be exploded by the blow of a hammer on iron.

Answer. That the Schultze powder may possibly be ignited by the blow of a hammer is a quality also possessed in like degree by black powder. The first authorities state that black powder "may be fired by the electric spark, and by percussion." This common quality has come under Captain Schultze's notice in his official capacity again and again, and he is prepared to demonstrate it at any time. Practically, the objection is invalid against either powder, because the conditions of ignition by percussion are such as are impossible of occurrence in storage, transport, &c., but so far as it goes, it in no degree whatever can be advanced against the Schultze powder as differing from black powder. They stand alike in this quality, as opposed to combinations of phosphorus, chlorate of potassium, and such like, which are capable of ignition under common and probable conditions. Whatever test, therefore, may be proposed, Captain Schultze is prepared to show will demonstrate the entirely similar qualities of the two varieties of powder, while, practically, he considers them valid against neither.

2nd Objection. That it is capable of absorbing moisture to the degree of 6 per cent. in twenty-four hours (I presume during an average state of the atmosphere).

Answer. That the Schultze powder is capable of absorbing 6 per cent. of moisture in twenty-four hours is not consistent with fact under the most trying conditions to which it has been submitted, the results of which gave an average of something under 3 per cent., so that in this respect it stands nearly on an equality with black powder, but with one very great difference in final results. While the hygrometric qualities are about equal, the effects of that absorption of moisture are very different, and all in favour of the Schultze powder, from this plain reason, that the combustion evolves gases which Captain Schultze has desired to retain by not charring his wood, and thereby depriving it of all hydrogen, which he actually utilizes in combustion. Captain Schultze does not assert that he desires an addition to the hydrogen gas already existing in his powder, but he does assert that the absorption of moisture in question has not the same diminishing effect upon its propulsive powers as it would have upon those of black powder. This question has also been practically and satisfactorily settled by the Prussian Government, which caused to be placed in the dampest casemate that could be found five barrels of each powder. After six months both were carefully tested by weighing and firing. The hygrometric tests were slightly in favour of the black powder, the actual absorption being of it as 2·20 to 2·80 of the Schultze powder, but the tests by firing were enormously in favour of the Schultze powder. The result of the exposure to damp for six months had reduced the propulsive powers of

The black powder	$8\frac{1}{2}$ per cent.
The Schultze powder	$4\frac{1}{4}$,,

These results are on record at Berlin, and the chemical causes of this superiority of the Schultze powder are perfectly understood.

3rd Objection. That its strength is modified by compression.

Answer. That compression exercises any special or peculiar influence on the powers of the Schultze powder is denied *in toto*. The common fact that it is proper to ram the powder well home in a gun is equally shared by black powder, if, indeed, it be not much more absolutely necessary in the latter to acquire equable powers of propulsion. Fantastic and nimious experiments of immense compression form no part of the question, and such pressure would alter of necessity the granular and other qualities of black powder in a much greater degree; in point of fact the objection is quite visionary. This answer is not theoretical, but founded on thorough experiments with both powders; these experiments are scientifically, but in no degree practically, interesting.

4th Objection. That it may be liable to self-combustion.

Answer. Decomposition, and consequently spontaneous combustion, are in the Schultze powder quite impossible. It may be stated here that during many years it was an especial task set to Captain Schultze by

Prussian Government to test this among the other qualities of GUN-TON. He had every possible means at command, and exhausted the stion. He is, therefore, enabled to assert, most authoritatively and hout the slightest fear of valid contradiction, that while gun-cotton, its organic construction, is highly susceptible of decomposition with its evil results, in his powder it is a physical impossibility.

th and last objection, that the different kinds of powder sent to gland in 1865, 1866, and 1867, were not of uniform strength.

Answer. The difference in the powders sent to England in 1865, 1866, 1867, arose solely from variations in the orders sent from that ntry. Any given standard can be absolutely maintained, and the ection is valid in no degree whatever; it would be quite as valid to ect to black powder, that it is daily made of different sizes and qualities rdered. The size of the grain and other conditions of the Schultze rder are simple matters of detail. It may almost be superfluous to te, in explanation, that German sportsmen use guns and shot ering in dimensions from those in use in England, and it is quite as y to regulate the Schultze powder for the smaller sizes of shot, and er calibre guns used in England, as it is for the English powder nufacturers to make it of various grains extending over six sizes, for zzle-loaders, breech-loaders, and for rifles. For instance, an equiva-t Schultze powder to No. 3 black powder, or any other size, can be solutely maintained.

It may be added, generally, that all these objections are exactly se which of necessity presented themselves to Captain Schultze's own nd in the first instance, but which have in every case been so dis-oved by experience in Germany, that he almost feels it idle to repel m now. Their being raised in England is, however, perfectly tural, and he is prepared to discuss or disprove them practically, if sired. As a practical gunpowder maker, a chemist, and an artillery ker, there is no part of the whole subject which has not engaged his tention. He has succeeded in his purpose—to produce an explosive terial to meet the requirements of the age; and, above all, as a source personal gratification, the manufacture of which is not attended by e slightest risk of property, or of human life.

General BOILEAU, F.R.S.: I believe there is a gentleman in the room who has perimented with Schultze's powder. I allude to Mr. Lang, perhaps he will our us with the results of his experiments.

Mr. LANG: I have generally found the samples vary, and I have not been able carry out the experiments as I could have wished.

General BOILEAU: It appears to me that the paper which has been read this ning exhausts the subject, and leaves really little room for more remarks: I , therefore, say very little upon the question as regards the details which have n laid before us. But there is one point on which it occurs to me that a word two might be said. It has been for a long time urged as a reproach against mical science, that while almost all manufactures—with very few exceptions, I ieve—in the whole circle of the arts have benefited by our progress in know-ge, gunpowder has not so benefited; and at the present day it is made from the e ingredients, almost in the same proportions, as when first discovered nearly centuries ago. I think, however, we may conclude, from what we have heard evening, that the reproach is about to be removed, if it has not been removed ady; and that if we cannot take it for granted that Schultze's powder is in a

condition, at present, to be generally used with the same confidence as black gunpowder is, the foundation for its future improvement has been laid, and we may look forward before long to the introduction of this new explosive agent with the same confidence, and with very much greater facilities of application, than in the powder which at the present time is used, both for sporting and military purposes.

Mr. LAMONT, M.P.: As a sportsman of some experience in different parts of the world, I wish to take this opportunity of mentioning, that since the month of October last, I have used this gunpowder at the recommendation of my friend, Mr. Dougall, nearly every day and with the utmost satisfaction, comfort, and pleasure. I have shot out of a common fowling-piece—12-bore—and I have no hesitation in saying, that the new powder will carry as far as black gunpowder. It makes very little smoke, very little noise, and with a total absence of recoil. Beyond that, I can only say that I think a great deal depends upon the way in which the cartridges are made, and especially upon the ramming.

The CHAIRMAN: As nobody else seems inclined to address the meeting, I shall close this discussion, because there is another subject to be brought before you by Mr. Read. He has made some lights which he wishes to exhibit. I think it is a matter of regret that Captain Schultze has not been able to be present himself to-night; still, I think, he has had a very able exponent of his gunpowder. Mr. Dougall has done full justice to the subject. It is certainly one of very great interest. I hope it will be taken up in this country, and that we shall hear of some experiments being made here, as well as in Prussia and France. I have not heard from Mr. Dougall whether any official experiments have been made here. I presume they have not.

Mr. DOUGALL: The powder has not yet been brought before the British Government.

The CHAIRMAN: I hope it may be.

Mr. DOUGALL: I have received a general order from the Lords of the Admiralty for testing, but nothing has been gone into at present.

The CHAIRMAN: I have no doubt, that if it is tested at all, it will be very carefully tested; for I rather think there is a Committee appointed to investigate the whole question of gunpowder and other explosive compounds, with the view of their being brought into practical use. I will now conclude with proposing a vote of thanks to Mr. Dougall for having read this paper to us.

Mr. DOUGALL: I am much obliged to you, Gentlemen, for the patience with which you have heard my paper, and also to Mr. Lamont, so distinguished a sportsman and Member of Parliament, for kindly coming forward and testifying to its qualities. I may state as a tangible proof of the excellence of this powder, that to-day I received from Mr. Lamont an order for gunpowder, for his use during the shooting season, four times greater in quantity than any order I have ever received during my long experience as a gun-maker.

Mr. STIRLING LACON: Black gunpowder or Schultze's powder?

Mr. DOUGALL: Schultze's powder.

HELM-INDICATOR, FOR THE PREVENTION OF COLLISIONS AT SEA.*

By Mr. George Read, R.N.

In the model of a steamer before you, is shown the manner by which the motion of the wheel, or tiller, can be made known to a ship approaching, even at the distance of three or more miles, by day or night.

A rope or chain is rove through a block, or cheek, at the masthead, from thence to a block hooked on the ship's side, and laid along the top rail or water ways through a tube to a block abreast of the wheel or tiller; the turns are passed under and over the barrel of the wheel, or to the end of the tiller if the rope or chain is placed on the barrel of the wheel. It takes two turns of the wheel to place the helm hard to starboard. If the circumference of the barrel be 14 inches, the light will be drawn up the tube 2 feet 4 inches, so that the hoist of the light can be regulated by the circumference of the barrel of the wheel or the length of the tiller.

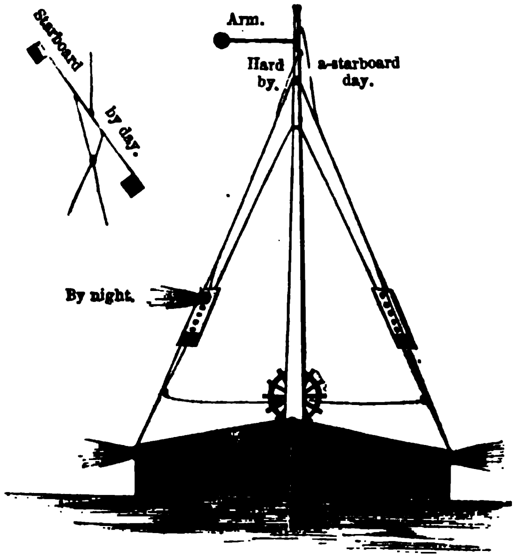
A line is made fast to a lamp on each side of the vessel, and this is drawn up a tube, showing, when up, a coloured light, corresponding with the present regulation light, so that whichever way the helm is put, two lights of the same colour will be shown.

The tube may be made of metal or wood, with an open front sufficient to show the same ray of light as the present regulation light. Holes are made in the after-part of the tube, with a view to show the officer of the watch what the man at the wheel is doing. The bottom of the tube forms a box to shelter the light when not in use; a brush can be placed inside of the front to remove salt water spray, &c. The lamp-box has a spring at the bottom, to prevent sudden concussion on the wheel flying round.

If the helm is put the wrong way, as is often the case, the officer in charge of the ship will be able to check the helmsman in an instant, and a ship approaching will see the same, and will act accordingly, and will do what judgment says is proper, for her commander will know that the officer is either undecided how to act, or the man at the wheel has misunderstood the order, and put the helm to port instead of to starboard. Should the man at the wheel be steering the ship wildly, the light will appear as if jumping from hole to hole, and should he fall asleep the light will remain stationary and show that the ship is going off her course.

There is a great advantage in having aft-holes in the tube, as the man at the wheel can thus see whether his helm lamp is burning brightly or not, and a ship coming up to another on the quarter will have sufficient light from the after part of the tube to know that the ship he is running up to, has starboarded or ported his helm to get out of his way.

* The helm-indicator and the apparatus for pier-heads, &c., are the joint inventions of Messrs. Read and Nunn.—Ed.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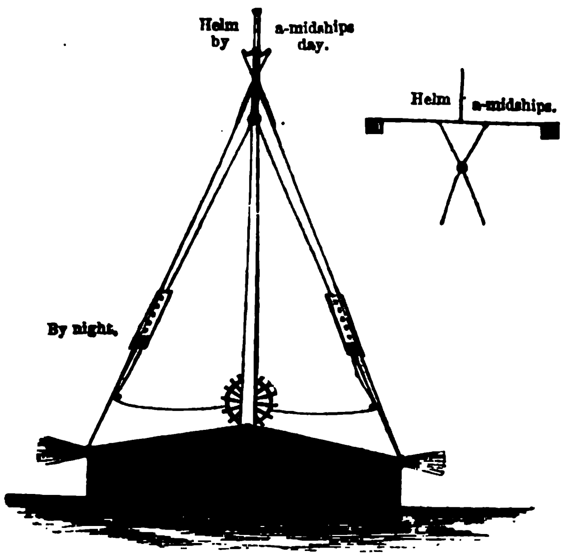
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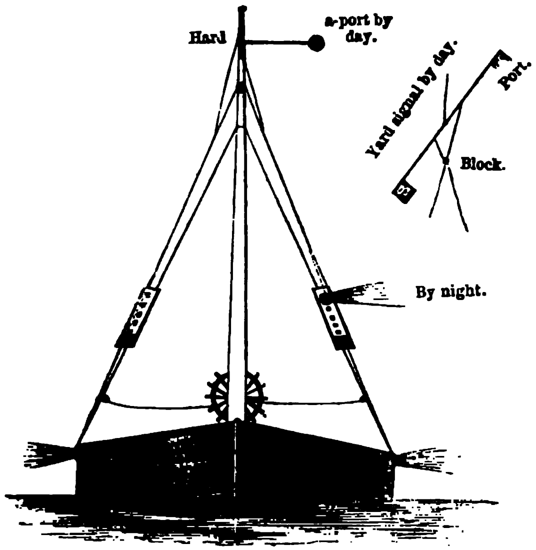
a-midships.
By night.

For day signals, a yard is slung by the centre as represented on the fore and mizen masts, with a line on each quarter to top it in a vertical position when the wheel is set in motion. The yard-arm has a *green* and *red* flag, one at each end, or a *green* and *red ball*. If the helm be put to starboard, the green flag or ball will be *up*, and the red *down*; if port, red *up* and green *down*.



The apparatus is so simple that any cabin-boy can rig or repair it when out of order.

By the use of this apparatus all speculation as to which side a ship will pass another is at an end. Should a collision take place between ships with this apparatus on board, it will show what party was in the wrong, and must do away with much hard swearing in the Admiralty Court, as the colour of the helm-light will be clearly visible and a note taken of it at the time of the collision—a most important thing—and no man can go into court and swear that *red* is *green*, or green is red, when there will be *two lights* of *one colour for* or *against* him. If A runs into B with starboard helm there will be two green lights and one red, if B ports his helm to clear A there will be two red lights and one green. No man can tamper with these lights, or can they be moved except by the man at the wheel, for it is only by moving the wheel that the lights can be set in motion; the wheel must revolve back the starboard turns to let the port come on.

The arm at the maintopmast head will be worked for a day signal, and can be made to work the lights also. If the helm be amidships, the arm will be perpendicular, if hard a-starboard, it will be horizontal to

the right of the ship, or starboard side, if port it will be to the left or port side. It can also be applied in a fog to touch two springs to strike a *gong* for starboard and a *bell* for port, as the end of the arm will be constantly in motion from *starboard* to *port*.

In rivers and roadsteads also the Helm-Indicator will be valuable for preventing collisions. The helm is generally lashed port or starboard, if *port*, the cable will be on the port bow, and a ship can then swing out of her position by starboarding her helm, which will shear her out of the way of a ship drifting down with the tide.

The use of this apparatus will also give a vessel a chance of anchoring in a clear berth. By the Helm-Indicator will be known the true position of the ship's anchor, according to the depth of water she is riding in, to a few fathoms of cable.

In naval tactics in the Royal Navy the use of the helm-indicator will be useful for day or night. The arm by day can be placed on a dial, similar to a clock face; the Admiral with a powerful glass would be able to see in an instant the difference of each ship's wheel under sail, and a note could be made of every ship's wheel in the fleet, to a spoke.

When engaged with an enemy, and the hull enveloped in smoke, the true motion of the rudder could be seen at the fore, main, or mizen royal truck. Tacking in succession ships will be able to follow one another during the night very accurately, as I propose to connect a trigger line to fire a gun, when the helm shall be placed extreme either way.

The apparatus, when complete, will cost but a mere trifle, and there will be no extra labour to the man at the wheel, as the gear aloft is equipoised. Once placed, it cannot get out of order more than the ordinary gear of a ship. The lights can be placed on any part of a ship, on a stanchion or outrigger, clear of all square sails.

APPARATUS FOR LIGHT VESSELS, TIDAL HARBOURS. DOCK HEADS, PIER HEADS, &c.

This apparatus, very similar to that I have just described, I propose to use in conjunction with the helm-indicator, to be placed on board light vessels at pier-heads, &c. The light keeper will see by the ship's indicator whether she is steering towards a dangerous part of the sands or not. Should such be the case, such a ship could be guided into safety by him. He would fire a gun, send up a rocket, and then show the helm signals, *starboard* or *port*, to the ship so running into danger. I am not aware that, at the present time, light keepers have any means of signalling to a ship. Many vessels are seen running along the edge of a sand with a dangerous spit ahead, that must certainly pick the ship up if she is allowed to keep her course.

The primitive way of signalling ships into tidal harbours such as

Dover, &c., is, by day, to swing an old hat right or left; by night, a lanthorn is swung, and that often in a line with the street lamps.

With my apparatus the deputy harbour-master has only to move the lever. If he wishes the ship to go more to the right, he has only to put the handle *right;* if *left*, to put the handle *left;* if straight ahead, put the handle up along the mast, and whatever the signal from the shore is, the ship, with her indicator, will do likewise, and then no mistake can be made.

Should my apparatus be adopted, any stranger could run for any harbour, without a pilot, with the greatest confidence. The deputy harbour-master knows the strength of the tide in such a harbour, and his judgment would be far superior to that of any one in charge of the ship. He looks over the pier-heads and sees the face of the current passing, and is able to make the allowance accordingly.

Commander COLOMB, R.N.: The lecturer, I think, deserves very great credit for the complete manner in which he has carried out his idea of a helm-indicator. I have seen three or four plans of that nature, and this one is certainly more perfectly carried out, in all respects, than any I have yet seen. There is no doubt, whatever, that if you have a means of indicating to an observer outside a ship, the state of the helm of that ship, you will go a certain length towards avoiding collisions; but only a certain length, because in eight collisions out of ten, the motion of the ship in the day-time, or a change from red to green or from green to red at night, does indicate a change of course either to port or to starboard. But that change of course is not generally taken advantage of as I think it ought to be. On the other hand, I may say that changes of course are often surmised where really they do not occur. Ships crossing the line of keel of another ship very often imagine that the change of colour in the lights means an alteration in the helm, when, in reality, it means no such change. Now, with such a plan as the present—supposing it can be practically carried out—we should get rid of that danger. But I think there is this to be said, that what one really does want most for the avoidance of collisions, is not a registry of the movement of the helm, so much as an expression of the intention of the person in charge of the ship. That we do not quite get in this plan, because the helm may be put one way and then altered again. However, as I said before it is a very complete plan, and it does the proposer very great credit indeed.

The CHAIRMAN: If no gentleman wishes to make any further remarks, I will, in your names thank Mr. Read for the very ingenious apparatus he has brought before us. We are all aware, at least all those who navigate ships, that it is a great desideratum to be able to know what the ship you are meeting is about to do. If you could always be quite certain that she would put her helm the right way, then, I think, that many collisions, that now take place, would be avoided. Any one who has seen the small river boats that navigate the Thames, will probably have noticed, that in meeting each other, though they do not, perhaps, observe what is technically called "the rule of the road," the captains hold out their arms, so as to indicate what they are doing, thus showing exactly which way each helm is put. I am quite sure that many collisions would be avoided if we had some simple apparatus, such as Mr. Read has brought before us, to indicate what a ship meeting another ship is going to do. I now, in your names, gentlemen, thank Mr. Read for the explanation he has given of his very ingenious apparatus.

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LECTURE.

Friday, January 31st, 1868.

General Sir JOHN AITCHESON, G.C.B., in the Chair.

LRY: HOW FAR ITS EMPLOYMENT IS AFFECTED BY RECENT IMPROVEMENTS IN ARMS OF PRECISION.

By Major-General Michael W. Smith, C.B.

ubject selected for this afternoon's lecture is the future employ- of cavalry with reference to the improvements in the construc- nd practice of artillery and small arms.

s subject involves a great deal; and during the short time at sposal in the present lecture, I can attempt nothing more than h sketch—a mere outline—of what my own opinions are, and also I conceive to be the opinions of many whom I have consulted, any whose works I have read. I must leave out the details, erely give an outline of the subject.

all, in the first place, read two short extracts from a work pub- in New York in 1863, entitled "The Employment of Cavalry— History and Management," by J. Romer, LL.D. The author is ing of rifled cannon and small arms, and states:—

ewhere we shall have occasion to examine the qualities of these new engines ruction, and the extent to which they are likely to affect the usefulness of . For the present, let it suffice to remark that the question has been ly resolved by those most interested in it, for all investigations to ascertain r the recently tried effects of the modern fire-arms justify the opinion that d troops will henceforth be unavailing, concur in the conclusion that here- avalry will be more indispensable than ever, and that nothing should be ed that can render it more efficient by either mounting it on better horses, loping the individual instructions of the soldier, or both."

ler the head of the *cavalry charge*, we find the following in the work:—

"It is not then that the fire of infantry is much to be feared, whether armed with rifles or with old smooth muskets, whereas the improvements of artillery all favour cavalry. Horse artillery now moves with almost equal speed, and acts in concert with the latter, while formerly these laboured alone. With such powerful auxiliaries, cavalry are unquestionably more formidable than before, and with horse artillery they must always destroy infantry, however good and tried it may be, for even, though the cavalry alone may effect nothing against them, the artillery will shatter them while they keep together, and when they attempt to deploy they must fall a prey to the horsemen. Thus, if the improved tactics of infantry have given them an advantage over the cavalry, the latter are even greater gainers by the improvement of the artillery, which, by accompanying them, affords them those favourable occasions, when to dare is to conquer."

Here we have the American opinion upon this subject; and as America has been the theatre of cavalry warfare in a certain phase, the opinion may be considered so far valuable.

The subject we have to deal with seems naturally to divide itself into three heads. In the first place, what have been the improvements in latter years in arms of precision? In the second place, what are likely to be the effects of these improvements? And, in the third place, what will be the best means of neutralizing or counter-balancing the great superiority which the practice of arms of precision seems to have gained in the present day all over the civilized world?

I shall now ask your attention for a few moments while I read a short extract from a well-known work of the present day, by an Officer of our own Artillery, well-known to military readers—Colonel Hamley—on "The Operations of War." I take this course, because, in the first place, I think it will save time, as Colonel Hamley conveys my own opinions, and what I believe to be the opinions of many others, more clearly and concisely than I could do it myself: in the second place, Colonel Hamley is an Artillery Officer, therefore, he may be considered more competent to judge of the improvements, and the consequent effects of such improvements, in his own branch of the service: and in the third place, Colonel Hamley's work has become, to a certain extent, an authority. His reasoning, conclusions, and illustration of facts, have not, as far as I know, been contradicted; therefore, I think his statements may be taken to convey generally the opinions of those professionally cognizant of the subject, at least as far as regards artillery matters.

The extract is as follows:—

"The introduction of arms of precision was the signal for numerous speculations, many of them somewhat extravagant, on the changes in warfare which would ensue. Some said all attacks would be impossible; some, that artillery would now be the chief arm, and infantry and cavalry mere escorts for the batteries; some, that the day of cavalry was over. This is by many degrees the most important question that can occupy the thoughts of contemporary soldiers, for it was by divining the relations between new systems and old, that Frederick and Napoleon rendered Prussia and France each for a time supreme in war. To discern and provide for the new conditions under which armies will engage, may, in the next European war, be worth to a people not merely armies and treasure, but liberty and national life.

"The first thing to be noted, is that the changes are not radical, like the introduction of artillery or of light infantry, but are only modifications of previously

existing conditions. To estimate the extent of these modifications will be an important step towards anticipating their influence on future military operations.

"The fire of infantry has extended its effective range from less than 200 to 600 or 700 yards. At 200 yards it is twice, at 400, six times, as effective as formerly.

"The effective fire of rifled artillery is extended from 1,200 or 1,400 to 2,000 or 2,500 yards.

"At first sight it would indeed seem that an advance against a line delivering such a fire would be impossible. But there are many circumstances to modify this conclusion.

"First. The calculation of the efficacy of rifle fire is based on the practice made by men firing singly at targets. File or platoon firing is very inferior in effect.

"Secondly. From 150 yards downwards, the fire of infantry, and from 1,100 yards downwards, the fire of artillery, is not more destructive to troops than formerly.

"Thirdly. In action, numerous circumstances lessen the effect of rifled arms. The adjustment of the weapon must be constantly changed in firing on an approaching object; and within the ranges of the old musket and the old field gun, the new arms are not more effective than their predecessors. Therefore, while within those ranges the effect is not increased; beyond them, the effect of fire on moving bodies is uncertain.

"Again, in almost all districts there are hollow ways and dips in the ground which may shelter troops even in what, at first, may seem to be a plain. Finally, the smoke of artillery and musketry, to which dust or fog may often be added; and the stress, moral and physical, of sustained conflict, are all of them influences which greatly diminish the effect of weapons requiring a clear range and a deliberate adjustment."

Elsewhere Colonel Hamley says:—

"It is argued that cavalry, always helpless when opposed to fire, will now receive such a storm of projectiles as will destroy it while still at a distance from the enemy.

"True as this may be of cavalry stationary in column, or moving uncovered on a flank, or halting to form for attack, it does not apply to the attack itself. Swiftness of movement is more than ever important, in passing over the region swept by fire, to close with the enemy. Cavalry can with ease move over 1,000 yards, ending with a charge, in 3¾ minutes. The speed of its motion would insure it against numerous or accurate discharges either of guns or infantry. Closing with the adverse line, it would have no more to fear from rifles than from muskets; and good cavalry has seldom been repelled by fire alone, but rather by the steady aspect of the serried line.

"One of the conditions under which artillery must exert its increased power of manœuvring, is association with cavalry. On the efficacy of the cavalry, therefore, must depend, in great degree, the efficacy of the artillery. But when associated thus, cavalry is no longer helpless against fire; the combined force can both attack and defend itself. Such companionship, then, is more than ever important."

Again:—

"Let us grant that cavalry will, in certain cases, suffer more than formerly. But as Napoleon used to say, omelettes cannot be made without the breaking of eggs. The losses must be compensated by increased efficiency, exhibited in power of manœuvring and determination in attack. Let us grant also that *bad* cavalry, when the lines are about to close, had better get out of the way; that merely *respectable* cavalry will, while supporting the other arms, effect nothing that can be considered decisive of a battle. But let it also be granted that cavalry, properly trained and led, may play as great a part as ever on the stage of war. Combined with new and larger proportions of artillery, its action may be decisive of the fate of battles; and launched in pursuit of a broken foe, it may finish a campaign which would else wade through fresh carnage to its woeful end.

"It will often happen that cavalry will best take advantage of sheltering ground by forming close column. But when exposed, it must deploy; and the general formation for manœuvre, which is supported by the most logical advocacy, is that of échelons of not less than squadrons. Whether there shall be one rank or two, one line or two, or in what manner the lines shall support each other, are questions for members of that part of the service to decide."

I shall now sum up and state shortly what I conceive to have been the purport of the extract which has just been read:—

I. *On the Nature of the Improvements.*

1st. A more extended range, obtained by substituting the rifled bore for the smooth bore.

2nd. Greater accuracy of aim, obtained by the adoption of improved modes of adjustment.

II. *Effects of the Improvements.*

1st. Impossibility of assembling the cavalry without protection at a distance within which they would formerly have been safe from the action of the enemy's artillery.

2nd. Impossibility of forming as formerly in the open ground out of range, and then advancing in attacking order to the assault.

III. *Best modes of Neutralizing or Counter-balancing such Effects.*

1st. To assemble the cavalry under protection of accidents of the ground from the view of the enemy, and from the fire of his artillery.

2nd. To form on the open ground in fighting order on a moving base, thus affording no standing mark to the enemy's artillery.

3rd. To support the formation and advance of the cavalry by the action of the horse artillery till arrived within attacking distance.

It is evidently with the last heading that we have to do at present.

First, then, to assemble the cavalry under protection of accidents of the ground from the view of the enemy and the fire of his artillery.

The assemblage of a body of cavalry, even of considerable force, within a distance of 2,500 or 3,000 yards of the enemy's position, under the protection of accidents of the ground, should not, under ordinary circumstances, be attended with much difficulty. There is hardly any ground upon which regular troops may be called upon to act, where shelter, either natural or artificial, cannot be found within the distance mentioned. Ground which, to the unpractised eye, may appear a level plain, will be found, upon inspection, to consist of slight and almost imperceptible undulations and dips, which will be found sufficient for the purpose required. This reminds me of a circumstance which occurred many years ago. The regiment to which I then belonged (the 15th Hussars), formed part of a brigade during

a field-day, under the divisional command of a General Officer now present. At the commencement of the field-day, the General, turning to an officer in command of a Cavalry regiment and some guns, ordered him to take up a certain position, but to conceal his force from the view of the enemy, supposed to be posted at a certain distant point. The Officer, with a look of astonishment, said it was impossible, as we were surrounded by an open plain; but it was soon pointed out to him, that by taking advantage of a very slight and almost imperceptible undulation of the ground which had escaped his notice, but had been detected by the practised glance of the General, he could place the horizon line between his own force and the enemy, and thus carry out the order he had received; this was the first practical illustration I had witnessed of this valuable appreciation of ground, and I have never forgotten it since. In all average ground certain accidents are to be found, scarps, ravines, villages, woods, walls, large buildings, even underwood and standing corn, if advantageously situated on a slight elevation, will be found to afford the protection required; for it must be recollected that if the cavalry can be brought up to their ground, and formed without being exposed to the view of the enemy, the point of assembly will be unknown, and consequently the range cannot be obtained. Districts doubtless do exist in certain parts of the world where actual level plains, without an accident or undulation for miles, are to be found, where, as far as the eye can reach, there is neither rock, tree, nor cover of any kind; but even on these level and unbroken plains there are certain elements existing, which might be taken advantage of to facilitate the assemblage of troops.

There is no time to discuss this point at present, but as far as regards the action of regular troops at the present day, these cases may be fairly considered as exceptional; the more particularly as the improvements in artillery and small arms with which we have to contend, have not as yet penetrated into the countries where these districts exist. We may therefore assume with Colonel Hamley, that in all European or civilised countries in which our troops may be called upon to act, the protection required for the assemblage of our cavalry will be found.

At this point Colonel Hamley states, "Whether there should be one rank or two, one line or two, or in what manner the lines should support each other, in short all questions relating to the actual details of cavalry movement and organization, are questions for members of that part of the service to decide." And from this point, I propose that we should take up the consideration of the subject.

Assuming the possibility of massing or assembling our cavalry in a protected locality, the next problem to be solved is, how are they to be extricated from such a position, and brought on to the open ground where the offensive action of cavalry properly commences, ra[illegible] smoothly, and steadily, without involving that disorder whic[illegible] prove fatal to all cavalry movement and action?—how are t[illegible] to be formed on the open ground under the fire of the e[illegible] which they will be exposed in consequence of the incr[illegible]

and accuracy obtained by modern improvements in artillery practice, without subjecting them to that murderous fire, which would render all efficient formation impossible, if attempted according to the old system?—and how are they to be brought up to the scene of action under the protection of the artillery in battle array or fighting order with unbroken ranks ready to deliver the assault?

From this point they will be under no greater disadvantages than formerly; and for the charge we must only trust, as in the old times, to the gallant leading of our officers, the good riding and pluck of our men, the training and spirit of our horses, and the blessing of God upon our cause. This has not failed us in the past, and please God, it will not in the future.

This idea which I have just brought before you of the cavalry onslaught, as it was called in the old times, is the idea which rouses the old chivalrous feeling in our hearts, and makes the cavalry service so fascinating and attractive. The ringing of spurs and scabbards, the gleaming of swords and helmets, the rush of horses, the shock of the charge, and all the "pomp and circumstance" of a cavalry attack,—this is the idea which rises before the mind's eye of our civil community, and perhaps of some of the junior members of our own branch of the service for a month or so after they join, before the attentions of the adjutant, riding-master, and drill-sergeant have dispelled the illusion,—that this is all that is required of the cavalry soldier. This is the scene so often depicted by our popular painters of cavalry subjects. This is the brilliant and exciting episode so often described by James, Lever, and other writers of cavalry romance.

This is the popular idea of cavalry action in general, and unfortunately the popular idea is that this is all, and that any one who attempts to introduce anything like method or calculation into the affair, must be in some degree wanting in the true spirit of a cavalry soldier. This, I think is one of the greatest obstacles to improvement in our cavalry arrangements. People forget or will not remember, that the days have arrived when we must sacrifice romance to method and calculated arrangement—that dash and daring alone will no longer carry everything before them.

We who have been brought up in the hard school of cavalry training know how much it really requires to bring the cavalry soldier up to the attacking point.

One side of the picture is very brilliant and attractive; but if we turn it and look at the other, the contrast is great. Here we see the drill-sergeant working assiduously in his vocation, and the adjutant in his, the riding-master's constant care in the training of men and horses, the veterinary surgeon working in his department, and above all, the commanding officer toiling at his daily and arduous task, through evil report and good report, through trials of patience and temper to bring all up to this attacking point.

This may appear an unpardonable digression from the subject under consideration, but it leads up to the following point:—that however brilliant and overpowering the action of cavalry may be, when once brought up to the attacking point, and launched against the enemy,

it requires much time, patience, consideration and method to bring it up to this point, particularly in the present day when it has so many more difficulties to contend with than formerly. The assault of a well-organized body of cavalry in good order will carry everything before it, more particularly if preceded by the immediate action of artillery. But there is no arm of the service so ticklish to deal with as the cavalry. A comparatively small matter will produce disorder; and nothing but ruin and failure can attend the attack of a broken and disordered cavalry.

The cavalry being assembled under the protection of some accidents of the ground, it follows that, unless in exceptional cases, the exit from such ground on to the open ground will be through roads, ravines, passes, or defiles of some description. The exit must therefore be effected by means of small columns of route which shall subsequently form on the move under the protection of the artillery. The organization of these columns must therefore be simple, and free from all complication, so as to admit of their threading their way through broken, difficult, or varying ground, without disorder. The subsequent formations from such columns to a fighting order, must also be perfectly simple, free from all complication, and above all, free from that restriction commonly called the law of pivots, so as to admit of a gradual and effective formation even under fire, and the influence of excited animals and human beings, in the midst of smoke, dust, noise, and all the tumult and confusion of cavalry action.

The artillery also should work with the cavalry, according to a method, the first principles of which should be well and closely calculated, the application being simple and practical, not acting at random, but acting in concert with the cavalry—an assured course of action, as well as a point of formation under the protection of the supports, or otherwise, being pre-arranged, when their action with the attacking force becomes no longer possible.

We now come to the final question up to which we have been working all this time. How is this column organization to be arranged? how is the formation from columns of route on the move to be effected? and how is the action of the cavalry to be effectively combined with that of artillery?

I think the answer is as follows:—By the means adopted in the present day for the carrying out of all the gigantic projects of modern improvement; by the means adopted for the furtherance of railway arrangements all over the world; by those means, the employment of which, produced those interesting results exhibited at the late Paris Exhibition, where all the triumphs of mechanical skill and elaborate manufacture were displayed on scales varying from the grandest to the most minute.

What these means are, I think can be stated in a very few words.

In the first place, to bring to our assistance, in establishing our first principles that calculus or method of calculation, comparatively modern in its application, by means of which we can arrive at sufficiently accurate results within certain and defined limits, even when the elements to be dealt with are variable; that wonderful power

which is applicable to subjects in which the deviation of even the hundredth part of an inch, or the tenth part of a second may materially affect the accuracy of the calculation, and also to subjects in which an error of miles in distance, or hours in time, will not produce a sensible error.

I shall not have to go beyond the first rudiments of this mode of calculation. The very simplest form of the calculus of variables will be quite sufficient for the work we have in hand. Nor should I have to use it at all, except that the subject we have to deal with, is subject to variation. Our paces vary; in our cavalry regulations the extent of the front varies; and the same with many other points in cavalry tactics. I have not time to discuss them at present, but this variation seems to have led people to the conclusion that cavalry movements cannot be brought to a matter of calculation at all.

The second means which I should propose to employ, would be to adopt that system which has worked so well in modern times, namely, that close attention to all minute details, that complete and perfect polish and finish of all the accessory parts, which has produced such wonderful success in everything around us. We see it in all the necessaries and luxuries of life, in our wearing apparel: in the wonderful accuracy and effects of machinery; in the texture of manufactured fabrics; in the illustration of our papers and periodicals; in short everywhere and in everything; but above all in the improvements in the action of our artillery and small arms.

I shall now come to the subject I have to deal with. I have divided it into three heads:—

I. *The organization of the column.*
II. *The formation to line or fighting order from column.*
III. *The movements in fighting order supported by artillery.*

And in each of these cases I shall endeavour to show how I should propose that the application of the means just indicated, should be carried into effect.

I. *Organization of the Columns.*

1st. *Relative Position of the Front and Rear Rank in Column.*

According to the present system, the front rank and rear rank men hold the same relative position in column as in line, with the exception of column of fours (eight men abreast), in which the front rank and rear rank are in line.

I should propose that the regimental column should consist, first, of the whole of the front rank in column, followed by the rear rank in column, both in column ranks according to the frontage of the column.

By this means a certain amount of complication will be avoided; the length of the column will not be increased; and all the column movements will be simpler and more regular. Other advantages are gained by this arrangement, which I have not time to mention at present.

2nd. *Directing or Regulating Point in Column.*

The leading and regulating point in field columns should be in the centre, as in line. By this means we gain a certain amount of uniformity, and consequently of simplicity in our arrangements; for the leading and regulating point will be the same, whether in column or in line. This is also the mode of leading in column adopted by other nations, even by those who lead by a flank in line.

The column being composed of rank entire, we can introduce troop and division leaders between the column ranks in field columns as low as divisions of eight.

The centre regulating principle will also enable us to diminish the velocity on the wheeling flank, which, according to the present system, is excessive, causing unsteadiness in changes of direction in column.

Frontage of the Columns.

I should propose that the columns should consist of—

Squadrons	32	Files
Troops	16	,,
Divisions	8	,,
Fours..	4	,,
Files	2	,,
Single Files	1	,,

This is evidently a geometrical series or progression, of which the common ratio is 2.

I have put the squadrons at 32, as I think this is the smallest force which ought to be employed as an independent fighting body. which a squadron might be required to be on occasions; and because I do not think it likely that, according to present arrangements, we shall be able to bring our squadrons in the field up to a higher number. As we have adopted the movement by fours instead of threes, it is, of course, desirable that the divisions should divide by four. Therefore, if we can bring squadrons of greater strength into the field, the series would be—

Squadrons	48	Files
Troops	24	,,
Divisions	12	,,
Fours..	4	,,
Files	2	,,
Single Files	1	,,

I have adopted the old denominations of files and single files, as, in the first place, a file of men has been generally taken to indicate two men, a single file one man; and as in rank entire, fours are formed *bonâ fide* of four men abreast, there is no reason for changing the old denomination.

I shall not enter here into the discussion as to the comparative advantages of fours and threes. Like many other things, there is a good deal to be said on both sides; but as fours have been adopted in our service, and approved of, I do not think there is sufficient reason to advocate a change.

It has been an old custom to divide our squadrons into troops. There may be much to be said in favour of this division, although it may not be essential, and, therefore, I should not propose a change in this matter either.

Working in rank entire, there are 16 feet from head to croup in column of divisions of eight. We can, therefore, introduce the troop and division leaders between the column ranks. According to the present system, there are only 12 feet from head to croup in column of divisions of 12.

In Colonel Baker's system, the rear rank is as formerly—at half a horse's length distance from the front rank. This gives a distance of 16 feet from head to croup in column; and as the division leader is at half a horse's length distance in front of his own division, there will be also half a horse's length distance between him and the rear rank of the division in front.

II. *Formations to Line, or Fighting Order from Column.*

Pace.—Our Cavalry Regulations tell us, that in the cavalry, the pace cannot be reduced to a matter of calculation, as in the infantry; but we are not told why the pace of the horse is not to be depended upon in the cavalry as the pace of the man is depended upon in the infantry; or why the arrangements as to pace generally, are not to be worked with the same degree of exactness and precision in one branch of the service as in the other.

As to the pace of the horse, I have had a long experience of many years in the matter. I first began to appreciate the exactness of a horse's pacing when I was a student at the Staff College at Sandhurst. In those days we used to sketch ground, as I think it is not improbable they do at the present time. At first I only used my horse when I was tired, or had some work to do which did not require any great exactness—such as filling in under features of ground, cross roads, &c., when, being surrounded by fixed points, I had no reason to fear an accumulation of error; but I soon began to find that the length of pace of the horse was more to be depended upon than I had any idea of. I then tested it upon the roads by the mile-stones, and seldom found the pacing in a mile out more than 30 or 40 yards. I could not do better than this myself, and consequently have since depended upon my horse, whenever practicable, for pacing distances.

I have surveyed a good deal of ground in India, Turkey, Asia Minor, &c., and have depended upon my horse for measuring the ground; and during those experiments, I found that the faster pace of the horse (16 miles an hour), when the horse takes about four yards in each stride, might be fully depended upon for measuring distance.

Those who have been employed in rapid sketching under difficulties, will know how valuable such an application of the horse's capacity in this respect, may be made. I have applied this mode of measuring ground to the movements of artillery combined with cavalry. I have had experiments made in this matter both in India and in this country, and several officers who were present, both of artillery and cavalry, could testify to the wonderful exactness attained by horses, even at their first trial. I did not expect or require more than an approximation—but I found the exactness to equal if not exceed the exactness of infantry pacing.

If such be the case, are we to cast this valuable assistance from us merely because the Regulations say it is unattainable? The power of measuring distances rapidly, and tolerably exactly under fire or in dust, smoke, &c., is more important now than ever, and this can be best done by holding your horse straight and counting his paces.

So much for the length of pace; as to the rate of pace, and combination of paces—although this seems to be treated as a matter of comparatively minor importance in our Regulations—it is the great power which the cavalry possess towards neutralizing or counterbalancing the preponderating effects of the artillery. The proper combination of paces gives us the power of making our formations on the move as it is called, that is, on a moving base, without affording a standing mark during the movement.

When we speak of pace or velocity, we must have some standard to measure it by. Our present standard, is miles in distance, hours in time. I should propose for a standard, seconds in time, yards in space or distance, and that the velocities or rates should be as follows:—

Walk	2	yards in	1	second.
Trot	4	,,	1	,,
Gallop	6	,,	1	,,
Gallop out	8	,,	1	,,
Fast gallop	10	,,	1	,,

The three first rates do not differ very materially from our present rates. The walk would be four miles an hour, as it is at present, the trot about eight miles an hour, the gallop about twelve.

Eleven miles an hour, if it is really ever done in the field, is very slow; in galloping past, the artillery cannot keep this pace; the traces won't draw. There appears to be no object in making the gallop so very slow. It will be seen that the standard of paces proposed, consists of an arithmetical series of five numbers, of which the extremes are two and ten, and the common difference two. There is no time to discuss all the merits of this question, but I think it will be apparent

how valuable such an arrangement might be made in the combination of paces, and, consequently, in formations on the move.

Formation en Bataille, or Fighting Order, from Field Columns.

The present mode of formation from column to line generally recognized, is by means of the oblique échelon.

I shall now say a few words as to the supposed advantages of this mode of formation, and also as to what I conceive to be the objections to this movement when applied to cavalry formations.

Oblique Échelon.

The advantages of oblique échelon with reference to the formation from column to line are stated to be as follows in the Cavalry Regulations:—

1st. The preserving a general front during the march.

2nd. Retaining the power at any moment to stop the movement, form line, and repel an attack.

As to preserving a general front during the march, the units forming the oblique échelon, all front to the direction in which they are moving, that is, upon lines at an angle of 45 degrees with the original line of covering of the column and the future line of formation. This would be so far good if they also preserved a fighting order during the movement; but, on the contrary, the leading troop or division, is the only portion of the échelon free to act offensively on the line of movement, the remainder overlap each other, and if they attempt to attack in that direction, they simply ride over each other and become a mass of inextricable confusion.

As to retaining the power at any moment of stopping the movement, wheeling into line, and repelling an attack, the only line which can be formed must be parallel to the original line of covering of the column, and at right angles with the future line of formation; and this line can only be formed, upon the supposition that the covering and distance of the échelons have been correctly preserved.

It would be reasonable to suppose, that the front formation was about to be made facing the expected point of attack; and it would hardly be reasonable to suppose, that without some extraordinary want of precaution on our part, the enemy should suddenly appear directly on our flank, and attack in a direction at right angles to the originally threatened line of attack.

It is possible that during the formation, the enemy might attack with part of his force somewhere about the angle formed by the future line of formation, and a line at right angles to it.

But for all purposes of attack in this direction, we are for the time being, helpless, in consequence of the overlapping of the units of the échelon.

I conceive the objections to the oblique échelon formation to be the following:—

)efective arrangements as to covering and distance.
Necessity of clearing the column in its whole length upon from a road or ravine, or when passing round the flank of :roops.
Necessity of an open right-angled triangular space free from s, of which the two sides are the line of formation and the line ing of the column, and of which the hypothenuse represents traversed by the rear unit of the échelon during the forma-l this is upon the supposition that the formation is made upon base—if it is made on the move, an additional clear space equired, represented by a parallelogram of which two of the each equal to the extent of front—and of which the two re-sides are dependent upon the combination of paces employed.
Movement scattered and unprotected during the formation, arly when the formation is effected on the move.
reservation of the covering and distance, is particularly difficult lry when in this formation, especially at the fast paces.
covering is taken along the front or rear line of pivots, even walk, it is most difficult, and at the faster paces, all but im-, to keep it; for even a slight wavering in the line of pivots, nging forward or hanging back of a single horse, a slight loss ing in any one of the ranks of the échelon, shuts out the view ine of covering, and, until the view of the general line is re-there is no guide whatever for the échelons in rear of the here the covering was lost.
nethod of covering also involves the difficulty attendant upon in one direction, and preserving the line of dressing in another; iires that the post of the leader of each échelon, with reference ring, be actually on the pivot flank of the échelon which he

osition of the troop leader in our service, in front of the second the directing hand, renders it impossible that he can pre-e covering upon this principle; hence arises a divided respon-the leader being answerable for the distance, and the guides covering.
produces a complication, where all ought to be simple and ncreases the number of links in the chain of responsibility, and ently the number of sources of error.
present case we not only increase the number of responsible by breaking up the squadron into two parts, but we add in what may be called a twisted link between the leader and p or body which he leads; for the troop must move and dress guide; the guide is responsible for the distance from the troop and the troop leader is responsible for the distance from the front; besides which, the guide must judge the covering for without any reference in that respect to the position of the

n scarcely be denied that this arrangement is bad; for surely ler of a body of cavalry in the field, when in presence of the should be wholly and solely responsible for the leading of the

[illegible] such an arrangement might be made in the combination of [illegible], and consequently, in formations on the move.

Formation of Battle, or Fighting Order, from Field Column.

The present mode of formation from column to line generally recognised is by means of the oblique échelon.

I shall now say a few words as to the supposed advantages of this mode of formation, and also as to what I conceive to be the objections to this movement when applied to cavalry formations.

Oblique Échelon.

The advantages of oblique échelon with reference to the formation of line from column to line are stated to be as follows in the Cavalry Regulations:—

1st. The preserving a general front during the march.

2nd. Retaining the power at any moment to stop the movement, form line, and repel an attack.

As to preserving a general front during the march, the units forming the oblique échelon all front to the direction in which they are moving, that is, upon lines at an angle of 45 degrees with the original line of covering of the column and the future line of formation. This would be so far good if they also preserved a fighting order during the movement; but, on the contrary, the leading troop or division, is the only portion of the échelon free to act offensively on the line of movement, the remainder overlap each other, and if they attempt to attack in that direction, they simply ride over each other and become a mass of inextricable confusion.

As to retaining the power at any moment of stopping the movement, wheeling into line, and repelling an attack, the only line which can be formed must be parallel to the original line of covering of the column, and at right angles with the future line of formation: and this line can only be formed, upon the supposition that the covering and distance of the échelons have been correctly preserved.

It would be reasonable to suppose, that the front formation was about to be made facing the expected point of attack; and it would hardly be reasonable to suppose, that without some extraordinary want of precaution on our part, the enemy should suddenly appear directly on our flank, and attack in a direction at right angles to the originally threatened line of attack.

It is possible that during the formation, the enemy might attack with part of his force somewhere about the angle formed by the future line of formation, and a line at right angles to it.

But for all purposes of attack in this direction, we are for the time being, helpless, in consequence of the overlapping of the units of the échelon.

I conceive the objections to the oblique échelon formation to be the following:—

t. Defective arrangements as to covering and distance.

id. Necessity of clearing the column in its whole length upon ing from a road or ravine, or when passing round the flank of ed troops.

d. Necessity of an open right-angled triangular space free from acles, of which the two sides are the line of formation and the line overing of the column, and of which the hypothenuse represents path traversed by the rear unit of the échelon during the forma-, and this is upon the supposition that the formation is made upon ulted base—if it is made on the move, an additional clear space be required, represented by a parallelogram of which two of the s are each equal to the extent of front—and of which the two re-ning sides are dependent upon the combination of paces employed.

th. Movement scattered and unprotected during the formation, ticularly when the formation is effected on the move.

he preservation of the covering and distance, is particularly difficult cavalry when in this formation, especially at the fast paces.

f the covering is taken along the front or rear line of pivots, even the walk, it is most difficult, and at the faster paces, all but im-sible, to keep it; for even a slight wavering in the line of pivots, springing forward or hanging back of a single horse, a slight loss overing in any one of the ranks of the échelon, shuts out the view he line of covering, and, until the view of the general line is re-ned, there is no guide whatever for the échelons in rear of the at where the covering was lost.

This method of covering also involves the difficulty attendant upon ring in one direction, and preserving the line of dressing in another; requires that the post of the leader of each échelon, with reference covering, be actually on the pivot flank of the échelon which he ls.

The position of the troop leader in our service, in front of the second from the directing hand, renders it impossible that he can pre-ve the covering upon this principle; hence arises a divided respon-lity, the leader being answerable for the distance, and the guides the covering.

This produces a complication, where all ought to be simple and in; increases the number of links in the chain of responsibility, and sequently the number of sources of error.

In the present case we not only increase the number of responsible ders, by breaking up the squadron into two parts, but we add in lition what may be called a twisted link between the leader and troop or body which he leads; for the troop must move and dress the guide; the guide is responsible for the distance from the troop der; and the troop leader is responsible for the distance from the op in front; besides which, the guide must judge the covering for nself, without any reference in that respect to the position of the der.

It can scarcely be denied that this arrangement is bad; for surely leader of a body of cavalry in the field, when in presence of the emy, should be wholly and solely responsible for the leading of the

how valuable such an arrangement might be made in the combination of paces, and, consequently, in formations on the move.

Formation en Bataille, or Fighting Order, from Field Columns.

The present mode of formation from column to line generally recognized, is by means of the oblique échelon.

I shall now say a few words as to the supposed advantages of this mode of formation, and also as to what I conceive to be the objections to this movement when applied to cavalry formations.

Oblique Échelon.

The advantages of oblique échelon with reference to the formation from column to line are stated to be as follows in the Cavalry Regulations :—

1st. The preserving a general front during the march.

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As to preserving a general front during the march, the units forming the oblique échelon, all front to the direction in which they are moving, that is, upon lines at an angle of 45 degrees with the original line of covering of the column and the future line of formation. This would be so far good if they also preserved a fighting order during the movement; but, on the contrary, the leading troop or division, is the only portion of the échelon free to act offensively on the line of movement, the remainder overlap each other, and if they attempt to attack in that direction, they simply ride over each other and become a mass of inextricable confusion.

As to retaining the power at any moment of stopping the movement, wheeling into line, and repelling an attack, the only line which can be formed must be parallel to the original line of covering of the column, and at right angles with the future line of formation; and this line can only be formed, upon the supposition that the covering and distance of the échelons have been correctly preserved.

It would be reasonable to suppose, that the front formation was about to be made facing the expected point of attack; and it would hardly be reasonable to suppose, that without some extraordinary want of precaution on our part, the enemy should suddenly appear directly on our flank, and attack in a direction at right angles to the originally threatened line of attack.

It is possible that during the formation, the enemy might attack with part of his force somewhere about the angle formed by the future line of formation, and a line at right angles to it.

But for all purposes of attack in this direction, we are for the time being, helpless, in consequence of the overlapping of the units of the échelon.

I conceive the objections to the oblique échelon formation to be the following :—

1st. Defective arrangements as to covering and distance.

2nd. Necessity of clearing the column in its whole length upon issuing from a road or ravine, or when passing round the flank of formed troops.

3rd. Necessity of an open right-angled triangular space free from obstacles, of which the two sides are the line of formation and the line of covering of the column, and of which the hypothenuse represents the path traversed by the rear unit of the échelon during the formation, and this is upon the supposition that the formation is made upon a halted base—if it is made on the move, an additional clear space will be required, represented by a parallelogram of which two of the sides are each equal to the extent of front—and of which the two remaining sides are dependent upon the combination of paces employed.

4th. Movement scattered and unprotected during the formation, particularly when the formation is effected on the move.

The preservation of the covering and distance, is particularly difficult for cavalry when in this formation, especially at the fast paces.

If the covering is taken along the front or rear line of pivots, even at the walk, it is most difficult, and at the faster paces, all but impossible, to keep it; for even a slight wavering in the line of pivots, the springing forward or hanging back of a single horse, a slight loss of covering in any one of the ranks of the échelon, shuts out the view of the line of covering, and, until the view of the general line is regained, there is no guide whatever for the échelons in rear of the point where the covering was lost.

This method of covering also involves the difficulty attendant upon moving in one direction, and preserving the line of dressing in another; and requires that the post of the leader of each échelon, with reference to covering, be actually on the pivot flank of the échelon which he leads.

The position of the troop leader in our service, in front of the second file from the directing hand, renders it impossible that he can preserve the covering upon this principle; hence arises a divided responsibility, the leader being answerable for the distance, and the guides for the covering.

This produces a complication, where all ought to be simple and plain; increases the number of links in the chain of responsibility, and consequently the number of sources of error.

In the present case we not only increase the number of responsible leaders, by breaking up the squadron into two parts, but we add in addition what may be called a twisted link between the leader and the troop or body which he leads; for the troop must move and dress by the guide; the guide is responsible for the distance from the troop leader; and the troop leader is responsible for the distance from the troop in front; besides which, the guide must judge the covering for himself, without any reference in that respect to the position of the leader.

It can scarcely be denied that this arrangement is bad; for surely the leader of a body of cavalry in the field, when in presence of the enemy, should be wholly and solely responsible for the leading of the

body which he commands; all ranks should look to him for guidance and direction; and divided responsibility should be avoided as much as possible.

It is not distinctly laid down in our regulations by what method the covering is to be preserved by the guides on the inner flanks of troops, and it is only by inference that we can come to the conclusion that the guides are responsible for the covering in oblique échelons as well as in column of troops.

If the principle of covering along the oblique line of the flanks of the échelons is not followed, the only remaining method is that of covering a particular file of the échelon in front.

In this case we are liable to the error produced by the opening out and closing of the ranks, as well as by the line of covering being broken instead of continuous. Altogether the system appears too complicated to be depended upon for rough work and rapid movements, and if the covering and distance cannot be preserved at all paces, and under all circumstances, we lose the great advantage supposed to belong to the oblique échelon formation, namely, the power at any moment to stop the movement and wheel into line.

The formation from column to line is laid down in our Cavalry Regulations for the regimental column only. It may therefore be intended, that in brigade movements each regiment upon coming on to the open ground should form independently: and therefore it would be only necessary to extricate the rear of the first regimental column before commencing a formation to fighting order. But this would mend the matter very little, for another necessity in the system of oblique échelon formations is, that the whole line of covering of the column from front to rear must be placed at right angles with the future line of formation, or, at least, at an angle not differing very materially from a right angle, as otherwise the whole arrangement of the system dependent upon all the units of the échelon except the first moving upon parallel lines at an angle of 45° with the line of formation, will be lost. Therefore before the commencement of the line formation in the last regimental unit in the column, the general base of formation must have advanced a distance equal to the entire length of the brigade column, or nearly so. This distance will be greatly increased if the formation is made on a moving base.

In all formations to line from column by means of the oblique échelon, the line of formation and the line of column form two sides of a parallelogram, upon the diagonal of which, the last unit of the échelon moves to a point opposite to its place in line.

The triangular space thus inclosed, is during the formation covered by troops or divisions (according to the frontage of the column) all moving on parallel lines to their separate points of formation. If there should be any obstacle, natural or artificial, within this space, it must of necessity break the line of covering of the échelon. And it has been already shown that this line is most difficult to retain, and almost impossible to regain, in rapid movement.

In the French service, the difficulty just mentioned, is got over by breaking up the general column into squadron-columns of divisions,

which move upon diagonal lines to sixty paces in rear of their points of formation in line. Each column then wheels so as to place the front of the column parallel to the future alignement; and the squadron formation to line is completed by the oblique échelon movement within the sixty paces.

If the formation is effected upon a moving base, a clear space, without impediments, represented by a parallelogram of which one side equals the line of formation, and of which the other is dependent upon the combination of paces employed, is necessary for the reasons already specified. During the process of formation, all the units of the échelon remain scattered about the field—totally unprotected and uncovered by the portion of the force already in fighting order—and if the formation is made upon a moving base, this helpless state of transition is sensibly prolonged.

From the moment that the last unit of the oblique échelon turns from the oblique to perpendicular line of movement with reference to the proposed line of formation, the whole breadth of the line is exposed as a mark to the aim of the enemy's artillery. And this without the efficiency and advantage of a line formation.

If the formation be made on the move, the dangerous and transition position of all the unformed portion of the force will be more or less prolonged.

Formation from Column to Line.—I should propose that the formation to line from column should be made indifferently to the right hand or to the left, or, as Colonel Baker expresses it, "a column should wheel "to either flank, or form to the left or right of its head."

I should propose that this inversion (as it is commonly called) or change of position of the units in line, or whatever it is proper to call it, should not extend lower than the column of fours.

Supposing a regiment to consist of four squadrons of thirty-two files, each squadron of four divisions of eight, and two troops of sixteen, the effects of the arrangements just proposed would be the following:—

The flank squadrons respectively would sometimes find themselves on the right flank of the regiment, and sometimes on the left. The centre squadrons would sometimes find themselves on the right of the centre of the regiment, and sometimes on the left.

The same would hold good with respect to divisions with reference to squadrons, and with respect to fours with reference to troops. As to the troops they would find themselves, one time on the right of the centre of the squadron, and another time on the left. Surely there is nothing in this to confuse the intellects of squadron troop or division leaders; it is not half so puzzling as acquiring and recollecting the rules relating to inverted movements in our cavalry regulations.

It seems now to be generally conceded, that as far down as columns of divisions, there is no insuperable difficulty in the matter; but if we speak of what is called inversion by fours, we are met by a look of distrust and a feeling of intolerance of so great a change; but after all, where is the difficulty in this case more than in the others? The right flank man of fours, remains the right flank man still: the left flank

man, the left flank man still; the right centre, the right centre, and the left centre, the left centre man still; and what possible difference can it make to any of these four individuals when they are ordered to wheel right or left, or about by fours, whether they happen at the time to be on the right, or on the left of their squadron troop or division? Surely we may trust the intelligence of our cavalry soldiers so far. We give them books, periodicals, comfortable rooms, easy chairs, writing paper, and in all respects treat them as intelligent beings, and I think we may give them credit for knowing in the field this small matter, particularly when we relieve their minds from other complications.

This last point gained, the great power we should acquire in facility of formation from column of route on the move, must be evident, and when it is recollected that this is one of the great desiderata of the present day, this facility of forming on the move from columns of route rapidly and effectively, I think it will be admitted that it is worth sacrificing a certain amount of antiquated prejudice to attain it.

Formation from Columns of Route.

The principles of the proposed formation are—

1st. That each unit of the formation, and consequently each rank of the column, should pass at once by a single wheel, made according to the principles of wheeling already specified, from column to direct échelon, and then to line.

2ndly. That the portion of the force still in column should be protected from the view and action of the enemy, by the portion already formed in line, and consequently in fighting order.

3rdly. That the formation should be made indifferently to either hand, on a moving base.

The velocity of this moving base to be completely under the control of the Commandant of the cavalry force, as also the corresponding velocity of the remainder of the column, the slackening or acceleration of which, with reference to that of the moving base, evidently modifying the time and space required for the formation.

4thly. That the distance to be passed over during the advance by the base of formation from the moment that the line formation is commenced to the moment that it is completed, shall depend upon the angle of inclination taken by the head of the column on issuing from the closed ground upon the open. This also will be completely under the control of the Commandant of the cavalry, and it must be plain how very important this latter would be, for there may be cases when, with reference to the position and movements of the enemy, a quick formation to a fighting order may be indispensable, while the base of formation passes over a comparatively short distance. On the other hand, there may be cases when it may be desirable to pass over a considerable distance at a rapid pace, exposing during the transit as small a front as possible to the enemy's artillery. It will be evident that in such a case a very rapid line formation would not be desirable, it would be only necessary that the formation to fight-

ing order should be completed upon arriving within attacking distance, and not before. There may also be an intermediate case between the two already described, when a moderate rapidity in the line formation with reference to the distance advanced by the base of formation, may be the most desirable.

III. *Movements en Bataille, or Fighting Order in presence of the Enemy.*

1. *Separation of the Ranks.*—According to the present regulation, the rear rank should be at a distance of one horse's length from the front rank; but we cannot expect this distance to be preserved in the hurry and excitement of action. The tendency of the rear rank horses when excited, is to press upon, or between, the horses of the front ranks.

I think that few will now contend that any additional impetus is given in the charge to the front rank by the actual pressure of the rear rank; in general, the tendency of a horse, when pressed upon by another, is to hang back or kick. If the rear rank should be held in hand as a support at some short distance from the front rank, a shot producing a casualty in the front rank may pass harmlessly over the heads of the support; whereas, if the ranks are close together, the same shot may produce a casualty in both. In any case, if a front rank man and his horse go down, it is ten to one that his coverer goes over him.

With the arrangement proposed, the squadron, or any other body of cavalry, will form from column of route, and show a fighting front in one half the time they could do so if working according to the present system. The assault could then be delivered at once, and in the meantime a really effective support would be steadily formed in the rear. By this arrangement the front rank squadron can be equalised, and kept up to a certain strength—say 32 file; for as the rear rank is intended to act as an independent support, it is not absolutely necessary that each front rank man should have his coverer behind him, or that the front rank and supporting rear rank squadrons should be of exactly the same strength; files may therefore be taken from the rear rank or support, to fill up vacancies produced by casualties in the front rank, without interfering with the exactness of the future movements in line. Skirmishers may be sent to the front from the support, without altering the intervals or extent of front of the front rank squadrons. The rear rank squadrons may also be used for flank attacks, or to protect the flanks of the front rank line; and if the action of the artillery should be combined with the advance of the attacking line to the last moment previous to the assault, the rear rank, or support, or a certain portion of it, will be in the proper place to support the guns, and their escort, when the first line has passed forward to the charge.

I find that there is not sufficient time now to enter into further details in this important matter, and shall therefore confine myself to bringing before you the opinions on the subject of high military authorities of former times, contained in the following extracts:—

Extract from a letter from F. M. The Duke of Wellington, K.G.

"*Strathfieldsaye, 20th Nov.*, 1838.

"Cavalry is essentially an offensive arm, whose use depends upon its activity, combined with its steadiness and good order.

"I think that the second rank of cavalry at the usual distance of close order, does not increase the activity of the cavalry. The rear rank of the cavalry does not strengthen the front rank, as the centre and rear ranks do the front rank of the infantry. The rear rank of the cavalry can augment the activity, or even the means of attack of the front rank only by a movement of disorder.

"If the front rank should fail, and it should be necessary to retire, the second or rear rank is too close to be able to sustain the attack or to restore order. The second rank must be involved in the defeat and confusion, and the whole must depend upon some other body, whether of cavalry or infantry, to receive and protect the fugitives.

"I have already said that the rear rank can only augment the means of the first rank by a movement of disorder.

"This is peculiarly the case if the attack should be successful. In all these cases the second rank, at a distance sufficiently great to avoid being involved in the confusion of the attack of the front rank, whether successful or otherwise, could aid in the attack, or, if necessary, cover the retreat of the attacking party, and thus augment the steadiness and good order of the cavalry as a body; while, by the absence of all impediments from the closeness of the rear rank, the activity of the front rank would be increased.

"It cannot be denied that, till required for the actual attack, the less cavalry is exposed the better. My notion of the distance of the lines of cavalry was as much as a cavalry horse could gallop in a minute; the second line should pull up at a walk when the first charges; the third and other lines in columns should deploy, or be used according to circumstances.

"I conceive that the one-rank system would require a change, not only in the discipline, but in the organization of the cavalry. If I am not mistaken, it would render the use of cavalry in an Army much more general than it is at present.

"WELLINGTON."

Extract from a Letter to General Bacon, from General Sir Hussey Vivian, G.C.B.

"As to the rank entire system, I am by no means certain that it would not always be a good thing, if on advancing to an attack, or standing in line, the rear ranks were to form a reserve at the distance, say of 80 or 100 yards; when so circumstanced they would be much better able to follow up an advantage gained by, or to repel a successful attack of, the enemy on the first rank. The fact is, that the second rank is but of little use but to fall over the first.

"R. HUSSEY VIVIAN."

Extract from a Letter to General Bacon, from Lord William Russell.

"Anything that proves the efficiency of the single-rank system is interesting to me; and it certainly was thoroughly proved on the 16th October, 1833, when your force of cavalry imposed on more than treble your numbers; this quite destroys the argument that a single rank 'looks so weak,' and 'invites the enemy to charge.'

Your adversaries were not to be tempted on the 16th. Keep notes of all the occurrences; we will one day put them in print.

"I am delighted to find that Vivian, (Sir Hussey) looked with a more favourable eye on the system. Depend upon it they will all come round. He wants to get off on the *mezzo termine* of leaving the rear rank behind. This I entirely disapprove, because the rear rank so left would have no one to command it, and cavalry depends entirely on its officers.

"There is no doubt that, if cavalry is to act in one rank, a different organization is necessary. You must turn your mind to this, as the end of the war brings to your aid the practical reflections you can make now. The Duke of Wellington is in our favour, but the prejudices of the cavalry officers are difficult to be overcome.

"WILLIAM RUSSELL."

Advance or Retreat in Line protected by Artillery.

According to the present system, the advance or retreat of a body of troops, is generally preceded by the fire of artillery directed against the troops and artillery of the enemy. But it would evidently be very advantageous, if the action of the artillery should also continue during the movement. This can only be effected by the artillery taking up consecutive positions, the distances between such positions being so regulated that the following conditions may be fulfilled:—

1st. That the coming into action or limbering up of the artillery in the advanced position, shall be protected by the fire of artillery in the rear position.

2nd. That the movement of the troops should be so arranged, that in the advance, the fire of the artillery in action shall not be masked before this purpose is effected, and that in retiring, the artillery in the rear position shall not be unmasked till the battery is in action ready to protect the limbering up of the advanced battery.

If we take the simplest case, and suppose two bodies of artillery (say two batteries) working with a body of troops, either cavalry or infantry, one on each flank, it will be evident that while the body of troops passes over the distance between the consecutive positions of the artillery, during which time one battery remains in action, the other battery must limber up, pass over double that distance, and come into action.

Allowing thirty seconds for coming into action, and the same time for limbering up, also taking the velocity of the artillery at the rate of eight yards in a second, or about sixteen miles an hour, the distance between the consecutive positions of the artillery will be found to be equal to 240 yards.

In trials both in this country and in India, I have found that the time allowed (thirty seconds) for limbering up and for coming into action was more than sufficient; but it is well not to hurry the movement, and sufficient time should be allowed for laying the guns.

The pace of the artillery also is not excessive, it is simply a fast gallop, and if even this rate of pace should be temporarily retarded by rough ground or otherwise, it would be only necessary that the cavalry should temporarily check their pace also till the obstacle was overcome, and the artillery again resume the original pace. This is a compensating power which does not exist in any mechanical con-

trivance or arrangement, inasmuch as it depends upon the human will and intelligence.

If either the cavalry or artillery are momentarily thrown out of the usual rate of pace by any circumstance, the Commandant of either arm, knowing the conditions to be fulfilled, and which have been already stated, can accommodate his own movements to this temporary change by either accelerating or retarding the pace of the arm which he commands.

I have no doubt that before long, some mode of expediting the process of coming into action or limbering up will be discovered; as also some improvement in the construction of artillery limbers and carriages, by lowering the centre of gravity or otherwise, which will enable them to move at even a greater velocity than at present.

Improvements in either or both of the points just stated would enable us to shorten the distance between the successive positions of the artillery, and consequently to lessen the distance at any moment between the cavalry and the artillery.

On Monday evening, March 2nd, Major W. H. Ross, R.A.,* will bring before you in this place his projects with reference to "Field Artillery on the Connected System," and I think it will be found that this matter is intimately connected with the points just treated of. As the matter stands at present, the artillery must be strongly guarded by a cavalry escort.

The two flank squadrons of the line might move on the outer flanks of the artillery, and when the line of cavalry passes the last position of the artillery, join the cavalry in the attack, protecting the flanks or otherwise as required, the artillery waiting for or falling back upon the support. In any case, the whole line of cavalry would reach the artillery in about twenty seconds, even upon the supposition that they were threatened by a close attack at the first moment of taking up their position.

The escort of cavalry will be sufficient to protect them from any sudden or partial attack, and the smallest exercise of judgment on the part of the Commandant of the attacking force, will prevent the possibility of their being exposed to anything like a general attack unprotected during the advance.

As has been already stated, the whole body of the cavalry could, if necessary, be up with the artillery in about twenty seconds, and this is upon the supposition that the cavalry are at the maximum distance from the artillery; but every moment that the latter remains in position, the cavalry are approaching closer and closer.

So long as the artillery position is closer to our own line of cavalry than to the force of the enemy, it is evident that before the latter can gain such position the cavalry will have reached the artillery and passed on to the attack, when the artillery can form with the supports, or take any course which may have been pre-arranged. Besides which, the first positions are taken up by the artillery upon the supposition

* See Journal of the Royal United Service Institution, vol. xii, page 72.—Ed.

that the enemy, although within range, are comparatively at a distance. In taking up the last position, the speed of the artillery may be increased; and as the distance between the attacking forces diminishes, laying the guns, &c., will not be of so much importance, and therefore the time allowed for coming into action may be reduced. The distance between the alternate positions of the artillery, and consequently the maximum distance of the artillery from the cavalry, varies directly with the time occupied in coming into action, and inversely with the velocity of the artillery; it follows, therefore, that in taking up the last position immediately preceding the assault, the distance between the cavalry and artillery, may be reduced.

In this case, as in all others, we must trust to the judgment and intelligence of the Officers in command of the forces employed, to modify their combined action according to circumstance. There may be cases in which the artillery might be compromised if more than two positions were taken up, and it might even be found inexpedient to take up more than one.

This action of the horse artillery during the advance or retreat of the cavalry does not of course preclude the adoption of all the old established arrangements with respect to the artillery action previous to or during the advance from fixed positions.

It must be recollected that even if the artillery are for a few seconds in a position in advance of the cavalry, the whole arrangement is effected according to a well considered method. The artillery are well protected, and in a few seconds the whole force of the first line of the cavalry would be up with them. It is unnecessary to enlarge upon the great power gained by carrying the action of the artillery with the attacking force of cavalry up to the last moment preceding the charge; to gain this great power, we must risk something. If we only recall to our minds the wonderful feats performed by this splendid arm of our service, the Horse Artillery, and the risks run without the protection and methodical arrangements indicated above, I think we shall come to the conclusion, that we need not fear their being compromised, because they are a hundred yards or so in front of the cavalry, when the enemy are at such a distance as to preclude the possibility of an attack before support can reach them. To gain anything in the present day, we must trust to well-calculated arrangements to obviate risk. This is done in railway arrangements all over the world; otherwise, railway traffic would be next to useless; without method and arrangement collision and accident would be imminent; but with a well-considered and methodical arrangement, the risk is reduced to a minimum. It will be evident that the formation to line on the move from column, or any other movement or formation involving a continuous advance or retreat of the base of formation, can be protected by the action of the artillery just described.

In all these cases, although the principles are closely and carefully calculated, it would be found (were there time to describe it) that the practical application was perfectly simple and suited for working in the field under all circumstances.

In a short lecture, like the present, it is impossible to enter into the

details involved in so wide a subject as that under consideration; but, I trust I have succeeded in giving you a general idea of the modifications in our present systems which I should suggest, in order to bring into action the means which I started by proposing as applicable to cavalry arrangements, and which have produced such wonderful successes in other matters to which they have been applied in modern times, namely, a close calculation of first principles, and an attentive consideration of all the minute details.

I find that I have already exceeded, by more than twenty minutes, the time generally allowed for lectures in this theatre, and, thanking you for your kind attention, shall now conclude.

The CHAIRMAN.—Gentlemen, I have to ask you for a vote of thanks to General Smith, for the able lecture we have had this day.

Evening Meeting.

Monday, April 20th, 1868.

Major-General J. T. BOILEAU, R.E., F.R.S., in the Chair.

NAMES of MEMBERS who joined the Institution between the 30th March and the 20th April, 1868.

LIFE.

Saunders, A. W. O., Captain, 21st R.N.B. Fusiliers. 9*l*.
Logan, Alfred, Lieut. Roy. Art. 9*l*.

ANNUAL.

Weguelin, J. C. B., Capt. 2nd Royal Surrey Mil. 1*l*.
Conybeare, Frederick, Lt.-Col. R.A. 1*l*.
Garforth, E. St. John, Comr. R.N. 1*l*.
Stafford, P. P. Leslie, Major M.S. Corps.
Addington, Hon. C. J., Major 38th Regt. 1*l*.
Varlo, Henry, Capt. h.-p. R.M.L.I.
Burgess, C. J., Capt. late Adjt. 9th Adm. Batt. Lancashire R.V. 1*l*.
Adams, Thos., Capt. late 39th Regt. 1*l*.
White, H. G., Capt. 1st Royals. 1*l*.

MUZZLE-PIVOTING GUN-CARRIAGE; LEVER, FULCRUM, AND INCLINE-PLANE PRINCIPLE.

By Captain T. B. Heathorn, h.-p. R.A.

The subject which I have the honour of again bringing before you, is one that I resume from the discussion, after Colonel Shaw's able and interesting lecture on his muzzle-pivoting gun-carriage, which took place here on the 5th June, 1865.

It may be remembered that I then first introduced to this Institution the lever, fulcrum, and incline-plane principle for muzzle-pivoting gun-carriages, producing drawings, and giving a short statement of my construction, which the Committee were kind enough to publish in No. 37, Vol. IX of the Society's Journal.

Although in those diagrams a counterpoise was shown in order to assist in lifting the weight of the gun, in my later constructions I have dispensed with it; not abandoned it as useless, by any means, for I still consider a counterpoise as a useful and effective adjunct for many circumstances, but I purposely omitted for the following reasons:—

1stly. Because sufficient was accomplished without it.

2ndly. Because, if required, it could always be added.

3rdly. Because it cost more.

4thly. Because the Ordnance Select Committee, who at that time I fancied were favourable to my invention, did not like the counterpoise as increasing the weight of the carriage, without commensurate advantage.

It is pretty generally felt here and abroad, that muzzle-pivoting gun-carriages will be used in the future to work guns through minimum embrasures, the advantages of which I will endeavour to set before you as follows :—

1st. Increased protection to guns and gunners; and as guns are expensive, and men scarce, both may be considered worth protecting. In a direct ratio to the size and power of a gun is the length of time between its discharges. Its powerful blows, though hard, are slow; and to the gunners behind a large embrasure, the annoyance from the enemy's riflemen would be disastrous.

2nd. A gun need not project so far through a small embrasure as through a large one to clear the port of back flash; it is consequently less likely to be struck by an enemy's shot.

3rd. A gun standing clearer back from its shield has room for higher angle of traverse.

4th. The sill of an embrasure will be about $1\frac{1}{2}$ feet higher than that of an ordinary port on the same "terre-plein," or deck—a great naval consideration.

5th. In every position of elevation, a muzzle-pivoting gun and carriage are considerably protected, being below the sill of the embrasure.

6th. Whatever angle of elevation or depression the gun may be at, the muzzle remaining in the same position in space, greatly facilitates the serving of muzzle-loading ordnance, and consequently simplifies the construction and arrangement of such necessary mechanical contrivances as are used to deliver charge and projectile to the hands of the loader.

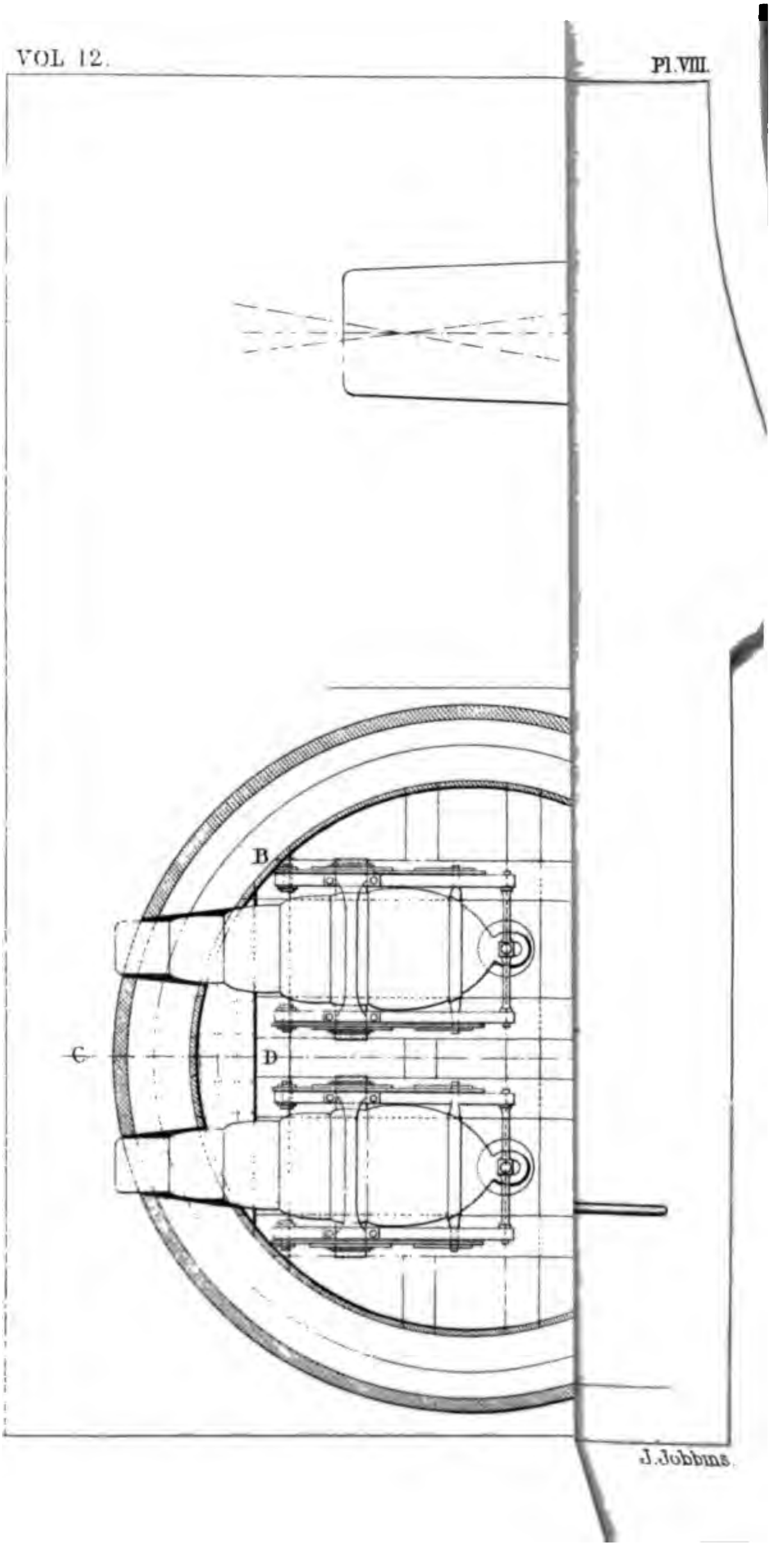
7th and lastly. A small embrasure gives a stronger shield.

For ordinary parapet and broadside purposes, a minimum embrasure does not so much interfere with pointing as may be at first supposed, although a small aperture necessarily gives a small field of observation, but the area is not so much lessened when the muzzle-pivoted gun is at either a high angle of elevation or depression, as in an ordinary port with a piece of ordnance mounted upon an ordinary trunnion pivoting gun-carriage. There, in elevation, the bulk of the gun crosses the field of sight in the embrasure, and prevents the captain of the piece from laying it on the desired object.

A series of careful experiments in this matter would bring forth curious and interesting information, and would be as novel as inexpensive.

The only one disadvantage, therefore, of using small embrasures, is the necessary adoption of muzzle-pivoting gun-carriages; inconvenient, I will allow, in having to lift so much more weight to move the gun through its vertical arc, but more than counter-balanced by the solid advantages of the strength and protection afforded by the minimum port.

Muzzle-pivoting gun-carriages, or rather gun-carriages so constructed as to pivot the piece at any required or pre-determined optional point in its lateral axis, may be classed under the three following heads :—



J. Jobbins.

Those that use an absolute support with he gun, to cause it to pivot on a point.	Mr. Mallet's first. Captain Blakeley's. Captain Scott's.
Those whose pivot is imaginary in space.	Colonel Shaw's. Gruson's. Lieut.-Col. Inglis's. The present Arsenal carriage. The Austrian carriage.
Those that use an imaginary pivot, but whose pivoting gear is wholly free from, and independent of, the power applied for notion.	Mr. Mallet's last. My own.

Upon the last-mentioned construction I will continue.

Early in 1865 I was impressed by the fact that the facilities for orking heavy guns did not keep pace either with their size, or ith the anticipation of the results to be achieved by them. Proper chemes for working appliances were undetermined, and it appeared o me to be such a new field of professional interest that I resolved to tudy the subject—with no particular benefit to myself, as it has urned out, but with a good deal of interest at the time, and ambition or results.

Amongst other things, I constructed the carriage before you, on the ollowing resolutions :—

To use a lever, fulcrum, and incline-plane principle, to lift the eight of my gun, and also create a pivoting motion on an optional oint.

To take the shock of recoil always at a right angle with the force of he recoil, the strongest part of the gun meeting the strongest part of he carriage.

As much as possible to avoid cog-wheel motion.

To make the muzzle-pivoting gear wholly independent of the appliation of power, so that derangement of the one might not interfere with he action of the other.

So to construct my carriage that for constant discharges at high ngles, it could serve as a good mortar bed. This is done by scotching p the trunnions in the slot of the carriage readily and efficiently with number of handspikes, balks of timber, or simply adjusted "quoins" nade for the purpose, and, if possible, to make my carriage serve oth purposes of muzzle- and trunnion-pivoting, the latter in case of erangement to the muzzle-pivoting gearing.

In March, 1866, I forwarded a model illustrating the principle of ny invention to the War Office; but I am sorry to say that then, as ow, in a general sort of way it was rejected and disapproved of, as napplicable to the service.

Soon afterwards Mr. Wells, an engineer, joined me in the matter, nd together we took out a patent for the principle and construction f what is here before you (see Plate viii, figs. 1 and 2), and may be hus described.

Two ordinary gun-carriage cheeks sufficiently high to hold the gun-

trunnions in every position of elevation and depression, bound strongly above by a massive cap-square, and equally firmly together at the base, embrace between them the gun they support. These cheeks are made of iron frames plated, or of wood covered with steel or iron plates, through bolted.

The gun-trunnions are caused to rise and fall in slots in the gun-carriage by levers fixed on either side, having for their fulcrum a common bolt. These levers may be placed either inside or outside the carriage cheeks; this was specified on my first introduction of this subject. In all these drawings I have placed them outside preferentially, because I consider their extra liability to injury in that position overbalanced by the greater facility of getting to them, in case of accident or other derangement. Moreover, the shoulders of the trunnions coming in closer contact with the slots in the carriage, take the shock of recoil better, do away with leverage, and give greater stability. But beyond this, there is no reason why, still using my system of levers and cams, the whole machine should not be boxed up, giving a perfectly flat side with no projections or working parts exposed in any way. The slots in the gun-carriage are the arcs of circles with the centre of the muzzle of the gun (or the required pivot) as centre; and the distance of same to centre of trunnion as centre radius. In each of these levers are two cams or slots—slots being preferable to cams merely because they strengthen construction, and tend to provide against disturbance by vibration; one pair of these cams or slots, act upon the trunnions causing them on the application of power to rise and fall as required; the other pair acting on a cross bar, adjust the proportional motion of the breech of the gun in excess of the trunnions, and produce muzzle-pivoting.

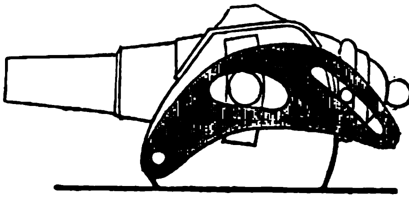
This is the principle of the pivoting gearing, and is always independent of the applied power, which may be from above to lift, from below to raise, by hydraulic ram, screw, pulley, steam power, or any other mechanical motion.

Power

Form of lever necessary, when power is applied to levers.

Power

Form of lever necessary, when power is applied to gun.



Form with slots, adaptable to both cases.

That the round surface of the trunnion, which at the time of the recoil strikes the slot in the gun-carriage at right angles to the force, may not cause a dent, but distribute its blow over a large surface, brass blocks to fit the slots are provided, in which the trunnions ride.

For naval carriages, I also propose to make use of the top of the cap-square, as a place to fix a strong eye or ring, to lash the gun-carriage steady to the upper deck in a sea way.

Further details of construction would here be out of place and uninteresting, I will therefore go no farther into them beyond stating, that the cams or slots in the levers are related to each other in such a way that the curve of the trunnion slot is always as nearly as possible at right angles to the vertical diameter of the trunnion, and the rear slot at as high an angle with the vertical diameter of the cross bar as circumstances will permit.

Although the plans I have here may convince you that this principle of muzzle-pivoting is applicable in many ways, I have still others showing various dispositions of levers and application of powers.

Early in 1866, I had the good fortune to be introduced to Admiral Halsted; he liked my invention, thought it applicable to the service, and induced me by his energetic example to persevere. Through his kindness and estimation of my system, I was enabled to show it in his "Model Turret Fleet of the Future," exhibited in the "Exposition Universelle," at Paris, last year. This was a great opportunity. International public opinion is a grand and fair criticism. I jumped at the chance of obtaining it.

Numerous artillerists of various nationalities, naval and military, were good enough to inspect my models, and by their favourable report recompensed me for my trouble. They gave me full credit for the originality of the idea, and the simplicity of construction; this credit I intend to hold on to as long as possible, and to it I think the fact of my introducing my plans to this Institution as early as June, 1865, entitles me.

Admiral Halsted's models will be exhibited at the School of Naval Architecture in the Kensington Museum very shortly,* and I feel quite absolved for the liberty I take in asking you to go and see my system there, by the pleasure I suggest to you, and which you will certainly receive, in inspecting his turret ships. In his broadside armament, all

* These models are now to be seen at South Kensington.—Ed.

the guns have a lateral traverse of 90°, 45" each way, which is only obtained by muzzle-pivoting.

In the spring of 1867 Mr. Wells and I were ordered by the Admiralty to furnish plans for a carriage for experimental purposes. It, however, was never constructed, and I was not treated well, for later I was informed that a somewhat similar plan was in the course of construction in the Arsenal for experimental purposes, and that no further steps regarding my carriage could be taken till the results of that trial were known.

"The Engineer" of this day, exhibits drawings of, and describes the latest carriage made in the Arsenal on the muzzle-pivoting, or rather approximate, muzzle-pivoting principle. My lever and fulcrum principle is adopted, and also the position of my fulcrum bolt. Muzzle-pivoting, however, is sacrificed for the always desirable object, of using lower power, the framers of the carriage contenting themselves with an approximation to it, and they are content to get a very limited vertical arc by dropping the muzzle, as they lift the body of the gun through space. But this is not a principle capable of extended development, for if any attempt is made to increase the vertical arc to what will be absolutely necessary, and give the gun a few more degrees of elevation and depression, the proportionally increasing passage of the guns "wabbling," muzzle will immediately demand a large embrasure. Both advantages of trunnion and muzzle-pivoting carriages are thus missed without participation in the advantages of either: and preferentially receiving the shock of recoil on the fulcrum-bolt and cogs, instead of allowing the trunnions to communicate it immediately to the body of the carriage, cannot be right. I very much object to, and disapprove of this construction as a very retrograde march, and a bad copy of my own.

I rather think that my carriage suffered from the following circumstances: viz., that I was instructed that all the running in and out gear, compressors, &c., in fact all accessories beyond the muzzle-pivoting motion were to be carried out by Captain Scott, R.N., consequently I furnished no detail for these matters; I was told to arrange for 7° depression and 10° elevation, and did so. Strange to say, on enquiry I ascertained, that the trial of my carriage had been objected to, chiefly on the grounds that it had no compressors, no running in and out gear, no buffers for recoil, and only went through a vertical arc of 17°. This was a very unfortunate circumstance for me, and I mention it because it has materially retarded the development of my plans and thrown me in the background, inasmuch as my statement that the English Admiralty were going to construct and experiment, prevented others from moving further in the matter until results were arrived at, and I have just received, curiously enough, a letter from Paris, wanting to know when the promised experiment was coming off, as much was pending on its success.

As you will not fail to notice, I commit myself to no particular system of running in and out gear, nor of compressor nor any other adjunct, buffers included, but I shall be happy to furnish muzzle-pivoting carriages to all who want them on this system, with simple

and effective gearing for compression, handy running in and out gearing, and buffers *ad libitum.*

This little model, my last construction, made for the French Exhibition, very well illustrates my plans. Since its return from France it has been deposited in this Institution. It has had a very great deal of handling, but has never been hurt by work. Its principle is exactly the same as shown in diagram No. 7.

Description of Diagrams.

No. 1 represents a 12-ton gun, muzzle-pivoted, side and end elevation with a vertical arc of 15°, viz., 10 elevation and 5 depression, forwarded to the Ordnance Select Committee early in 1866, it is worked by two vertical fixed screws assimilated in their action by worm-wheels on a common spindle acting on cog-wheels at the base of each. These screws cause the cross bar through the cascable and the rear slots in the levers to rise and fall as desired.

No. 2 represents the same gun, with the same levers, going through the same passage as No. 1, but with a different application of power; this was forwarded along with No. 1.

A powerful worm-wheel on either side works into a toothed sector, with A as centre; at that end which gives motion to the cross-bar and causes it to rise, an eccentric is provided, to allow for the action of the two constricting radii, C A and A B. Here the cross-bar does not go through the cascable, but underneath it, to leave it free for Mr. Whitworth's rear vent, of which I think a great deal, and which will be adopted, in all probability, some day abroad, if not at home.

No. 3 and No. 3a (see Plate viii, figs. 1 and 2) show side and rear elevations of the carriage, designed for the Admiralty at their request about this time last year, by myself and Mr. Wells, for a 12-ton gun, Government pattern. The checks are strong iron frames, iron-plated on either side. It is on the toothed-sector and worm-wheel elevating principle, the same as No. 2, but the eccentric is simplified by parallel motion and the levers connected together by a cross-bar.

Its vertical passage is 7° depression and 10° elevation, and it is also applicable for using Whitworth's rear vent.

It is calculated that four men will elevate it at the rate of 15° a minute.

Although the handles for working it appear low, they are not so in reality, for when we come to consider the thickness of the slide for broadside guns, or corresponding baulks in turret arming, it will be found that there is plenty of room, and the handles are in comfortable working position.

In both cogged-sectors, five teeth bite the worm-wheel at the same time, and thus the evils of cog-wheel motion are modified.

The bolt head near the worm-wheel shows a through fastening, serving both to bind the cheeks of the gun-carriage together, and to guide and keep the toothed-sector to its work.

No. 4 shows a plan and elevation of a carriage giving 10° depression

and 15° elevation, to one of Mr. Whitworth's 70-pounders. This is to be seen in model, in Admiral Halsted's combined Turret and Broadside System, shortly to be placed in the School of Naval Architecture, South Kensington.

This carriage is constructed of wood, steel-plated, the whole mass bolted together, which for cheapness and strength is considered very good. The power is a fixed vertical screw, worked much as No. 1 is worked.

The levers are shorter than those of the others, and the cross-bar is superseded by a pair of light trunnions on a belt.

No. 5 diagram shows the advantages of muzzle-pivoted guns, in command and protection over the usual trunnion-pivoting system, the amount of freeboard obtained, and the difference in the size of the necessary port.

The section represents Admiral Halsted's combined turret and broadside system.

No. 6 is a drawing of a gun-carriage, giving to a 600-pounder four degrees of depression and ten of elevation, designed for Captain Cowper Coles, C.B., September, 1866.

Like No. 4, it has short levers and a fixed vertical screw.

The fixed vertical screw is, I find, objected to by many, but this objection I do not participate in; the cascables of all guns mounted with this power, are slotted so that little or no vibration can be communicated to the screw; and as the trunnion-boxes in which the trunnions ride, are in close contact with the carriage, and communicate the shock at once to the carriage, I do not see what the screw has to fear. I tried the experiment of firing a little model I have in Paris, with a considerable charge, in fact, as much as it could hold; and though I bent one of the trunnions (which were rather too slight in consequence of having been turned down to fit friction-wheels upon), and smashed the table, I did not harm the screw. If any one will fire an ordinary musket with about three charges, he will find that the somewhat severe shock of recoil comes directly against his right shoulder, and may knock him down, but his left arm is not interfered with; the lever, in fact, of my carriage.

No. 7 shows almost the same plan as this model, with an ascending and descending screw. The box through which it descends, forms the centre of a large bevelled wheel supported underneath by a cradle working on trunnions, through the centres of which run the spindles bearing the small bevelled wheels communicating power.

I bring to your notice this plan of a pair of guns in an ordinary "Captain Cowper Coles turret" (Plate viii, fig. 3) to show as clearly as possible what the requirements of a muzzle-pivoting gun-carriage really are, for turret purposes. First of all the chase of the gun must be free from and project beyond the carriage at least as much as shown at C D, as the muzzles must clear the port, and the gun-carriage cannot run out further than B.

Approximately-muzzle-pivoting guns cause their muzzles to wabble up and down, in a diminished port truly, but with a very restricted vertical arc; but a very restricted arc is very unsatisfactory and

inefficient—for in the future, turret ships, will not only have to counter-batter their adversaries at low angles of elevation; but with 20° or 25° elevation for their guns, they will have to run in and bombard high surrounding land works, to be silenced and overcome in no other manner.

These elevations will never be got by any other than absolute muzzle-pivoting carriages, at least if a small embrasure is thought necessary; with a large one, as heretofore, the present system is simple and efficient.

I read a paper "on muzzle-pivoting gun-carriages for naval armaments," on the 3rd instant, at the Society of Naval Architects, in corroboration of the advantages of which system, the Assistant Constructor of the Navy, Mr. Barnaby, thought, that "I (Captain Heathorn) would be "glad to hear that the Brazilian Government, who had been engaged in "war, and who had been very successful, had had ships built of different "forms, but that their latest was a casemate vessel of 1,000 tons burden, "in all essential particulars like the old 'Research,' except in the par-"ticular that the guns fitted to her were muzzle-pivoted. The only "serious defect they had observed in the ships, was the largeness of "the ports, and, considering that the river was very narrow in the "front of the forts with which they had been engaged, it had been "a most serious matter to them."

Admiral Halsted also observed, that "immediately before he had "left Paris one of the last visits paid to inspect his new system was "by Lord Lyons, and on showing him the mode of elevating the "guns, he had said that if the Northern American monitors had had "such means of elevating their guns, it would have put a stop to the "warfare many months before. They could not elevate their guns, "and they did not dare to list their ships for fear of exposing their "bottoms."

This statement strongly backs up the necessity for having muzzle-pivoting gun-carriages, so constructed as to allow the guns to be laid at high angles of elevation, and be well protected from enemies' bullets pouring in through the ports. At the same time Mr. Mallet said, as a matter of fact, that he could state "that a 12-ton gun, giving 10° of elevation, and 15° of depression, could with muzzle-pivoting, be manœuvred between the decks with the arc which at present existed, leaving some inches to spare." He endorsed entirely what I had said as regarded the importance of muzzle-pivoting, stating that, "whatever might be the height of the port, if you had a muzzle-pivoting gun, there was no room for water to come in. And that whether on land or at sea, the larger you made the embrasure the more you weakened the structure of a shield."

I now conclude my paper, Mr. President and Gentlemen, by thanking you for your kind attention.

Captain MITCHELL, R.E.: Though not an Artillery Officer, but an Officer of Engineers, I should like to ask Captain Heathorn a question. Captain Heathorn has informed the meeting that the War Office rejected his gun-carriage as inapplicable to the Service. Has he any objection to tell us the reasons the War Office gave for not adopting his gun-carriage? Probably, they gave those objections in detail; and no

doubt it would be very interesting to the meeting to hear the reasons that the War Office assigned.

Admiral Sir HENRY CODRINGTON: There are one or two questions on the subject that I should like to ask. First, as to the stability of the gun at sea when elevated; because, as it is elevated considerably, the movement of the ship would then have much more effect than when it is at its lowest position. Next, whether any of the thrust of the gun, or the recoil of the gun in short, comes upon the bolt that I see at the cascable, or what actually bears it? What takes the thrust of the gun? I should also like to ask him a question as to the ease with which the damage that may be made by an enemy's shot, or by accidents and the wear and tear that there is in action, may be repaired?

Lieutenant-Colonel CONYBEARE, R.A.: I think Captain Heathorn stated that one of the advantages of his lever principle was that it afforded the means of elevating the gun on the old method, by moving it on its trunnions in case the lever got out of order. Perhaps he would be kind enough to explain to us what arrangements he would adopt for doing that?

Admiral CODRINGTON: I understand that the whole weight of the 12 tons is to be raised each time on the levers—the whole weight is to be raised on those cogs?

Captain HEATHORN: No, the weight is divided between the fulcrum and the cogs.

Captain MITCHELL: There are a large number of garrison carriages in the service. If Captain Heathorn's carriages are brought into the service to supersede the present carriages, I should like to ask him how far he could adapt the existing garrison carriages so as to meet the requirements of the plan which he proposes to introduce?

Captain HEATHORN: In answer to Captain Mitchell's first question, of the reasons why the Government objected to my carriage, I have never had such a definite explanation that I could give him. "Inapplicable to the service" has been the great reason urged. I never could get very deep into the subject, therefore, I regret to say I can give Captain Mitchell no further information upon that point. As regards the adaptation of the present garrison carriages to muzzle-pivoting, I do not think the present old wooden carriages would be very useful; and perhaps it would scarcely be desirable, because they are for mounting smaller guns than we are constructing. Now I do not think any alteration in that particular way would be an advantage. Muzzle-pivoting gun-carriages will only be used with minimum embrasures. Minimum embrasures with their expensive shields will only be afforded to very prominent positions. Then, again, I very much doubt whether the whole course of fortification at the present time is not undergoing a considerable *boulversement*. It is just a question whether shields, except in very particular positions, or rather I may say permanent works, will not have to give way to another system of artillery, of which my friend Captain Moncrieff is the originator, and which I believe in for certain purposes. As regards the stability of these muzzle-pivoting carriages in a sea-way, both in broadside and turret ships, I think you will remember that I propose to place rings or such fastening gear on the top of my carriage, as would in a sea-way fasten broadside carriages in a position of stability to the upper deck. In turrets I propose, as shown in Admiral Halsted's models (to be placed in the South Kensington Museum), so to construct the top of the carriages, that they may run under guiding rails, and prevent that upsetting which would occur by the oscillation of the vessel. As regards the recoil being taken by the bolt, it is a thing which I think is extremely objectionable; but I regret to say it is what the Government have adopted in their last construction, where they have used my levers, and have taken, as will be seen in the number of "The Engineer," of April 20th, 1868, the whole of the recoil on the bolt. I suppose they have a good reason for it, but I am unable to find it out. In the case of repairs to muzzle-pivoting gun-carriages, as in everything else where anything like mechanical attributes are used, duplicate parts must be provided. There are not many required in my construction; there are not many in most constructions; but duplicate parts would be provided. There would be spare levers; there would be a spare screw gearing. If the screw-gearing gave way, the ordinary handspike and quoin arrangement, with a purchase from the top if they can get it, or pressure from below, will be brought in to work the gun through space. The arrangements for converting the gun into a trunnion-pivoting gun would be very simple. It would be merely to

knock off the levers, then it would be a trunnion-pivoting gun. One of the models on the table shows it very well; take off the levers, and it becomes a trunnion-pivoting gun.

Admiral CODRINGTON: It would not then work through the ports.

Captain HEATHORN: A gun on that model would not, but one on the other would; it has, you notice, an oscillation below the screw.*

Mr. ROBERT MALLET, C.E.: I beg to make a few observations, if not too late, on the paper of Captain Heathorn. As I claim to be myself the first and original inventor of muzzle-pivoting ordnance, it could not be supposed that I intend to say anything in dispraise of the general principle of muzzle-pivoting. I must, however, say that Captain Heathorn, in stating that in the event of a muzzle-pivoting gun being disabled, you could revert with it to the ordinary method of trunnion working, is to claim for muzzle-pivoting a power which it does not, and on no possible construction ever can possess. Therefore, I hold that Captain Heathorn is entirely in error in that opinion. You cannot by any mechanical arrangement, re-convert a muzzle-pivoting into a trunnion gun, if you are to derive the advantages which muzzle-pivoting is intended to offer, and without which it is of no value, viz., the reduced aperture. Captain Heathorn will agree with what I say, and I think he must inadvertently have made his statement, that that is one of the advantages of muzzle-pivoting. And it is not unimportant that it should be corrected, because the very essence of muzzle-pivoting is this, to reduce the aperture through which the gun fires, to the size of the muzzle of your gun, so that except at the moment when the gun is withdrawn by the recoil, it is not possible for a shot to enter the hole at all. Therefore it is not likely that the gun will be dismounted in the way that ordinary guns are. It is quite possible it may be dismounted by a shell bursting inside; or it is just possible it may receive a downright facer by a shot coming through the hole and striking the muzzle; or it may be deranged more or less by a shell bursting inside. In all these respects the muzzle-pivoting carriage is on a par with the old constructions, but in its main advantage of the reduced aperture, it is far before them. There are various plans already produced by different persons for practically carrying out this method, or "system," as it was called. That construction will practically be best which is the simplest and cheapest, provided it fulfils the conditions required for perfect muzzle-pivoting. The great point to be attended to in the design of a muzzle-pivoting carriage, is to get a carriage of the simplest possible construction. It should have as few parts as possible beyond the existing carriage. There should be nothing above the level of the gun itself at any time; and it should be such that, if a naval gun, you could pin the whole thing down to the slide, and pin the slide down to the deck; so that no matter what movement the vessel might take, the gun could not by possibility get loose. As an inventor and a patentee of muzzle-pivoting, I do not think it would be graceful were I to criticise that particular construction invented by Captain Heathorn, and referred to in the paper. On the importance of muzzle-pivoting itself, Captain Heathorn and I, and other inventors, are thoroughly agreed. It is *the* point presented for the improvement, as regards the future, of mounting ordnance. There may be other plans, such as that of Captain Moncrieff, which offer great advantages, perhaps. I myself was one that saw vast difficulties in making that system practically useful, for it is one thing to make an exceedingly ingenious looking machine, but to make one that shall stand the rough usage of actual warfare, is another thing. Muzzle-pivoting is the mode to be adopted with ordnance to fire behind the shields of casemates, for if you want to make a strong shield you

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* Captain Heathorn wishes the following memo. to be inserted:—"I thought "Admiral Codrington meant, that if the levers were taken off it would not work as a "trunnion-pivoting gun-carriage, hence my reference to an oscillation below the screw. "I never wished in any way to state that my muzzle-pivoting carriage minus the "levers, could produce muzzle-pivoting. What I wished to explain was, that without "levers it was a perfect trunnion-pivoting gun-carriage, the same power applicable in "both cases. The advantage of a gun-carriage, with both muzzle-pivoting and trunnion-pivoting action, is, that one pattern is better than two."—ED.

must have a small aperture in it. But a few years ago the authorities flouted the idea of muzzle-pivoting as utterly absurd; they have since altered their views, and a member of the Ordnance Select Committee itself has even become an inventor and a successful one of one form of muzzle-pivoting carriage. I believe that the authorities are now at last quite alive to the importance of the method. They are, however, taking a very questionable mode of getting the problem best solved by getting this or that Officer or person to adopt without acknowledgment, portions of plans devised by others, and precluding inventors from having their methods completed and fairly tried under their own direction. Some of the designs which I have seen, said to be on board the "Minotaur," are certainly only worthy of being called attempts to evade the rights of inventors.

The CHAIRMAN: I wish to ask Captain Heathorn whether the pattern of the carriage he sent for the "Captain" has been adopted or not?

Captain HEATHORN: Here is the drawing that I sent up to the Admiralty, at their request. They were going to adopt it; why they did not I have not yet heard.

The CHAIRMAN: It has not been adopted?

Captain HEATHORN: No, except that this (referring to the drawing in the "Engineer" of the Government carriage) was brought out at the Arsenal afterwards.

The CHAIRMAN: I think I am only expressing the sense of the meeting when I offer to Captain Heathorn our thanks for the paper which he has read to us this evening. The subject is one which is very nearly new, and like many similar subjects which have had, if not their origin, certainly early notice in this theatre, it will produce results which I have no doubt will be considered in a national point of view as of great importance, while it is creditable to those who have brought it forward. There appear to be some differences of opinion in respect to the arrangements of this muzzle-pivoting carriage, which Captain Heathorn has brought before us; but there is no doubt whatever—and I quite agree with what has fallen from the talented inventor, who last addressed the meeting—that for the future muzzle-pivoting will be *the* system. With regard to guns on shore, fortifications as well as artillery are undergoing a transition; they are now in a state in which nothing can be considered as settled. Much is under experiment; much will probably have to be altered, although we may have the elements of what the future will be, both of guns and of fortifications. But as regards ships, this system appears to me to have pre-eminent excellence, inasmuch as it reduces the ports through which the guns are fired, to their *minimum*—it admits of guns being trained to almost any requisite amount, and elevated or depressed through very many degrees without the aperture into which the muzzle of the gun is forced being enlarged unnecessarily in either direction. There appears to be one point which has not been noticed with regard to the ports for these muzzle-pivoting guns. It is in respect of their training, that a large portion of the iron-plating has to be cut off, to admit of the gun being moved laterally. Now, it is evident that this weakens to a certain extent the armour-plating of vessels. But we must take into account the extreme improbability of a shot hitting one of these ports. If we take the diameter of a port at 14 inches, which will give a surface of one foot, and take the side of a ship as between 3,000 and 4,000 superficial feet, the chances that the shot will hit that hole are as 3,000 or 4,000 to 1; that is almost saying that they would not hit at all. But not to enter into a discussion on a subject of which the discussion is closed, I will merely offer on the part of the meeting our thanks to Captain Heathorn for the valuable paper which he has read, and urge him to persevere in his invention. I trust the same success will follow his endeavours to bring forward this carriage, and other modified carriages on this system, as has happily attended the efforts of others who have favoured this Institution with explanations of their inventions, and which have had for their object, the improvement of our defences. I am sure that we all feel greatly obliged to Captain Heathorn, and to other Officers who come forward with the same good will that he has shown to-night, and demonstrate such beautiful illustrations of their systems as hang upon these walls, and who initiate here inventions of great national importance, and which cannot fail to make their way among continental authorities, as well as with our own Government.

LECTURE.

Friday, May 8th, 1868.

MAJOR-GENERAL SIR H. C. RAWLINSON, K.C.B., M.P., in the Chair.

THE MILITARY ADVANTAGES OF A DAILY MAIL-ROUTE TO INDIA THROUGH TURKEY AND THE PERSIAN GULF.

By HYDE CLARKE, Esq.

IN the year 1859 I had the honour to read before the members of The Royal United Service Institution, a memoir* on the adoption of the hills of India as strategic bases, instead of the plains. The object of the system of hill occupation and settlement I advocated, was to increase and strengthen the European element in healthy positions, not only as a means of repressing insurrection, but as a barrier against invasion from the north. The necessity for protective measures on that side has not become less in ten years. I now take advantage of this opportunity to bring before the members of the Institution another subject closely allied in ideas and principles.

The means of communication with our armies in India by any route, is of value to us, but the simple transport of troops may not be the sole consideration. This, quick steam transports can accomplish by sea route around the Cape. Still, the speediest means of conveying intelligence and Officers charged with special duties, is a matter of military necessity under emergencies; thus we are led to consider the land routes. That by Egypt accomplishes our objects to a considerable extent; but such are the contingencies to be regarded, that we cannot, in prudence, restrict ourselves to one route, were the Egyptian route even the shortest attainable. Thus all routes that can be opened are of value, even including the far northern route by Russia and Persia. This, from various circumstances, is being fully and rapidly developed, and

* "The Organization of the Army of India, with especial reference to the Hill regions," see Journal of the Royal United Service Institution, vol. iii, page 18.—ED.

we may before long find, that the routes which are really intended fc attacking us are more advanced than those which ought to be availab for our assistance and defence. We have at the present moment on one overland route, and that of a precarious character—the Egypti one—one considered by some persons to be essentially English, a yet it is one liable at any time to be interrupted by the efforts of t Viceroys of Egypt to accomplish independence, or by the prepond rance in that country of some foreign power.

There is another route—the middle route—which has only be partially explored, and never put in practice. I mean that route t the railways of Europe, Constantinople, Asia Minor, the Valley of th Euphrates, Bagdad, Bussorah, and the Persian Gulf, with which, fc nearly fifty years, the name of General Chesney has been inseparabl connected,* and in the promotion of which so many distinguishe members of this Institution have taken part. The time is now fas approaching when, if we do our duty, we shall complete this grea undertaking, and if we do so, we shall effect very much more than th construction of a railway route, for we shall, at the same time, an without separate or further outlay, accomplish great political opera tions, which will not only strengthen our military resources, but ten thereby to protect ourselves and Europe and Asia at large, from th danger of attack.

In considering a subject of this kind, it is fortunate that it can b brought before an audience which is not commercial, and which ca therefore properly appreciate its moral elements, for although, after a military administration must ultimately rest upon material resource and, therefore, really and truly enter into the domain of political ec nomy in the operations of capital; yet capital is not the only element such and other transactions in the world, nor the sole aspect und which they are to be regarded. It is the misfortune of politic economy, because it is its essential condition that capital shall b chiefly regarded, and as political science is in this country less studie and developed than the science of political economy, it does happe not only in commercial circles, but also in the Legislature, th technical considerations of political economy often acquire too muc preponderance. Thus when our political existence may be the questio really at stake, the discussion may be made to turn on theoretical co siderations of Government interference, and, therefore, operations capital. While we have been arguing these principles, and leavin the middle and Euphrates' route to the action of the speculators Europe, the French Government has devoted its energies to the Su Canal, and the Russian Government to the execution of its land road Persia. Therefore, under these circumstances, it is fortunate that t matter has to be discussed by a profession so far untrammelled by t primary prejudices of theoretical science, and accustomed to deal wi questions under their moral and political aspects, those, in fact, b which this and many others must really be decided; because th

* See Paper read at the United Service Institution, by General Chesney, i 1857.—Ed.


ROUTES OF
COMMUNICATION WITH INDI
Railways completed
Do constructing
Do proposed
Route by Steamer
Existing Telegraphic communications
Proposed Do Do
Shetlands
Orkneys
Hebrides
SCOTLAND
IRELAND
ENGLAND
NORTH SEA
London
Hanover
Berlin
Amsterdam
Brussels
Calais
Havre
Cherburg
Paris
Strasbourg
PRUSSIA
Dresden
GERMANY
Prague
Munich
Vienna
AUS
Bay of Biscay
FRANCE
Berne
Macon
Milan
Venice
Trieste
Mt Cenis
Turin
Genoa
Bordeaux
Marseilles
Bilboa
SPAIN
Madrid
Portugal
Lisbon
Corsica
Rome
Naples
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Sicily
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welfare of commerce depends on the maintenance of peace, and for this the exact percentage of returns cannot be regarded. So far as the railway before us is a matter of reproductive enterprise, it is to be left to the volition of capitalists, but so far as it is a matter of political necessity, it must be urgently provided for, and not left to the chance of a Brazilian railway presenting more profit, or of a Portuguese railway affording a larger margin of shares to be appropriated by the promoters. The result may be, nay, has been, that in leaving this undertaking to the free-will election of capitalists and speculators, their preference has been shown for railway and other works, of no material benefit to our political interests.

This, therefore, is the issue on the present occasion; and it is the true issue before the Governments of England and India, and before the Legislature, to determine whether the route is really practicable, justifiable, and of essential necessity; if so, it then lies with the authorities interested, to find the best means of accomplishing the task, with the least disbursement of the national resources. It is idle to ask whether the undertaking will pay such and such a dividend, if it be in reality a necessary portion of our political machinery. It will then be fortunate if, instead of being like much of our military material—utterly unproductive—it should afford the means of ultimately repaying the requisite outlay. This is the true mode of regarding the subject, not beginning at the wrong end, and seeing whether it is, in the first instance, captivating to capitalists, but whether, in the first instance, it is necessary and beneficial to us as a nation.

The general course of the route has been already sketched. It is a short and direct route to India, and with which, only modifications of itself, can compete. The European railway system reaching to Basiash on the Danube, is the first and existing portion. The second is that lying between Basiash and Constantinople in Turkey in Europe. The concession for this has been granted to a combination of Belgians, English, and Hungarians, under the name of the Vander Elst and Company. At present the company is weak, and Turkish finance is weak, so that no very brilliant career can be augured for it, but this may safely be predicted, that the enterprise will be accomplished. There are portions of the line valuable for local purposes, for which the Ottoman Porte will obtain its resources, and the new political ambition of Hungary will encourage the extension and development of its railway system to the East.

The third portion is that concession granted to Mr. Greig, Messrs. Sharpe, Stewart, and Co., and Baron Winspeare, being the line of railway from Constantinople or Scutari, across Asia Minor to Aleppo, and thence by what has been called the Euphrates Valley Railway to Bagdad and Bussorah. The short concession from the Ottoman Government to the Euphrates Valley Railway Company having lapsed, this route forms an integral part of the new concession, and not, as has been lately described in some papers, a separate and distinct route. The third or Asiatic portion may be divided into two sections, the Northern and Asia Minor section, and the Southern and Euphrates Valley section.

The fourth portion is now in activity by the running of steamers between Bagdad, Bussorah, and Bombay. It will ultimately be replaced by a line of railway connecting Bussorah and Kurrachee, and joining the European to the Indian systems.

There are thus two portions of the route in activity, one in progress, and the remainder, the Scutari and Bussorah Railway, only in embryo, but without the execution of which we cannot obtain the advantages of the entire route. The topographical features are those which would interest many members of this Institution, and the discussion of which would be of great benefit, from the local knowledge they can bring to bear on the subject. This would, however, require time. It will be sufficient to say, that on the northern portion, the chief difficulties are in the northern mountains and in the passage of the chain of the Taurus.* The latter are the most considerable. On the southern section, the chief portion is easy, but the branch from Aleppo to Skanderoon or Alexandretta passes over a mountain range. The portions surveyed are from Scutari to Ismid and Eski Sheher, and from the Mediterranean to the Persian Gulf. Much of the line would be remunerative from local traffic, but in the present state of Turkish finance, its construction on such grounds cannot be expected.

The Turkish guarantee is 5 per cent. on £20,000 per mile, but this guarantee must be dismissed from the mind. It is of no immediate value, and only ultimately available as a collateral security. No one has, therefore, proposed to raise capital on this guarantee, and many newspapers have been led in error to discuss the project as dependent on this guarantee. The consideration of such guarantee must be abandoned, and the undertaking must be established on a different basis. What are of value, are the several sources of revenue appropriated by the Ottoman Government to the undertaking. Such are the Indo-European telegraph revenue, the Indo-European postal revenue, and subsidies from the several governments, the transit duties of 1 per cent. on merchandize, and the revenue of the passenger and goods traffic. Thus the Ottoman Government has, so far as it can, transferred to the new undertaking all its own available rights and revenues, and there can be no doubt that it would be further disposed to assist. The cost of the line is estimated at twenty millions, a sum which is considerable, but not beyond the resources of the enterprise.

If the railway could be economically constructed, and worked for a few years, no competent authority doubts but that it would yield a fair return, but no one who has experience believes it can be at once remunerative. What, therefore, is wanted is such assistance in credit as will raise the money on the lowest terms, and cause the least outlay for interest, and also such temporary accommodation as may be required during the early stages, to be repaid from the ultimate resources of the undertaking and the collateral guarantee of the Ottoman Porte. The burden of the whole of this temporary accommodation to the home and Indian governments would not be

* See a paper by me, "On the Daily Mail Route to India," in the Society of Arts Journal, vol. xvi, p. 275, Feb. 28th, 1868.—H. C.

heavy, while the revenue and political advantages would be great; but there are other governments which have political and commercial grounds for sharing in the operation. The pecuniary assistance would take the shape of postal subsidies, and in the end there would not even be pecuniary loss.

The military aspect of the question may be regarded under three heads.

1st. The conveyance of intelligence.

2nd. The conveyance of Officers, soldiers, and small stores.

3rd. Defensive and offensive resources, resulting from political consequences.

Rapid intelligence is at all times an essential military necessity, and the first element in effective movements. If this is the case in the field, or in a campaign, it is of the greater moment when the army of operation is so far removed from its real base, as India is from England. This was most sensibly demonstrated during the mutiny. Our Governments have since then devoted much attention to the improvement of the telegraphic and postal communications. An essential part of the telegraphic communication has been established by the middle route now under consideration, and it requires little argument to show that its maintenance is imperative, even if a cable route should be laid south, and particularly in consequence of the Russo-Prussian route being made effective.

Postal communication has its absolute military value apart from commercial value. In neither case is this value determinable by the pecuniary return in postal revenue. It includes the transmission of orders, reports, requisitions and returns, and the quicker the transmission, the more effective will be the condition of discipline and administration. As by the southern route, railway transit can at the utmost be extended to Brindisi, while through Russia it must be circuitous, so by the middle route is it direct, and the quickest mode available.

This brings us to the point of what is the period within which, mails can be conveyed by the middle route. Taking 25 miles per hour in the first instance by railway, and 10 miles by sea, this will give us—

London to Bussorah	144 hours	6 days
Bussorah to Bombay	160 ,,	$6\frac{2}{3}$,,
Total		$12\frac{2}{3}$,,

By acceleration of railway trains at a more advanced period, and assuming a rate of 30 hours, we get—

London to Bussorah	130 hours	5 days
Bussorah to Bombay	160 ,,	$6\frac{2}{3}$,,
Total		$11\frac{2}{3}$,,

From Bussorah to Kurrachee the voyage would be about 5 days,

giving a total transit to Kurrachee of 11 days in the earlier periods, and 10 days on greater acceleration, thus realising Lieut. Waghorn's prophecy.*

With a railway along the coast, at a speed of 25 miles per hour, the distance from London to Kurrachee will be ultimately accomplished in 8 days, to Bombay in 10, and to Calcutta and Madras in 10 or 11 days.

Some persons will make a very small account of the saving of one day between London and an Indian station, but the saving is more, for there is the saving of the day on the return mail, and on the future correspondence. In this instance, so soon as the railway is extended to Bussorah, instead of a weekly mail to India, we should get more frequent communication, and with a complete railway transit we should obtain to all India what we now have to most parts of Europe—a daily through mail.

Thus at present the course of post to Bombay is 51 days; this will be progressively reduced to 25 days and to 20 days, giving us 18 courses of post in a year, instead of 7, and materially increasing and improving the communication of Departments, and of course rendering still greater facilities in connexion with the telegraph. In 10 days a document could be obtained from most parts of India, or a written or detailed order transmitted there on application by telegraph. The private advantages must be correspondent to the public benefits.

The second head for consideration is the conveyance of Officers, men, and small stores. For Officers despatched in cases of emergency, there would be the same acceleration as for mails, and in case of need, an Officer could pass from London to India in 8 or 10 days. This would not be the ordinary course, though on emergency an Officer could visit England or India and return in a month. In the more usual way some portions of time would be spent in repose, or in seeing the more remarkable cities on the way, and thus the journey would be prolonged. In case of need, sleeping accommodation would be provided in the trains, and the mode of travelling which is now adopted as far as Basiash would be extended to Bussorah, and ultimately to Kurrachee.

There are many obvious reasons why the main body of troops going to and returning from India should not be sent through Europe by railway; but still the route may be materially shortened and facilitated as compared with that through Egypt. The route for troops will be by steam transport from England to Scanderoon instead of to Alexandria, from Scanderoon by the Aleppo branch and so to Bussorah, and thence again by steam transport, with the advantage of passing by the Persian Gulf instead of by the Red Sea.

It will be seen that the Euphrates Valley section becomes, in case of need, an independent means of communication reaching from the Mediterranean to the Persian Gulf, and available as an alternative communication with the northern line, and more particularly available if the northern section be stopped. In its early stages, and as an alternative, it affords a route from Brindisi, Trieste, or Salonika to Scanderoon, and thence by railway to Bussorah.

* See Journal of the Royal United Service Institution, vol. x, p. 287.—H. C.

e undertaking has consequently to be considered under a double t, as a through line connected with the European system, and as iphrates Valley line.*

the conveyance of Officers, troops, and stores, these routes would us very great advantages, and the Euphrates Valley route would cessible to us so long as we maintain naval communication by the terranean or on the Indian Seas.

these respects, the undertaking has a strong claim on our Govern- s for contribution and support.

now come to the third head for consideration, viz., the political ons of the middle route; and here it may be useful to pass briefly any questions affecting Western, and more particularly regard rn Europe, where exist the chief elements of difficulty and danger peace of the world.

stria and Hungary will, by the extension of their railway system east, accomplish an ardent desire, and obtain another channel for ercial development as well as for the advancement of their n provinces. In a political point of view, this double empire has reatest interest in effecting these objects, because it would be gthened on the frontier most threatened and assaulted, the eastern orth-eastern. Austria would thus be enabled to take an effective n the Lower Danube, and give military assistance to her chief n ally, the Sultan.

nature of the route throughout, is such that it affords a secure ry base, well within the frontiers and districts exposed to attack, indeed, were the line from Basiash to Bussorah laid down by ry men for purely military purposes, it could scarcely be better d. What it wants to complete it, is, sets of lines from this o the scenes of attack, and these will in due course result from ecution.

nature of the main line is this. From the Austrian junction, it s of Austrian troops being thrown in along the whole line at the of the Danube for the protection of that frontier, and, in case of of operating on the south against Servia. The European line les for the movement of Turkish troops from Constantinople or serves in Asia for all purposes of defence, and for the protection lgaria, as the Varna and Ruschuk Railway assists in the east.

Constantinople contingents from the western powers can be landed nveyed into the interior of European Turkey either for active ses, or as a reserve, or as an army of observation in support of sh or Austrian troops.

m the moment that the Basiash or Belgrade and Constantinople in operation, the political situation of the Principalities will be ed. Now, not only the Servian Slaves lean to the threatening of Russia, but the Rouman-speaking Wallachians are compelled kle to a hostile state. There is nothing on the spot able to or to protect Roumania or Servia except Russia. On the other

* Captain Tyler's paper "On Routes of Communication with India," Journal Royal United Service Institution, vol. x, p. 276, 1866.—H. C.

hand, an allied army of English, French, Austrians, and Turks would be able to defend Roumania against its natural enemies, and compel Servia to obey its engagements with the European powers. Our resources could be made available because the route touches the sea at several points. At Constantinople there is access to European and to Asiatic Turkey. By the Gulf of Scanderoon our fleet could land supplies for Asia Minor or the Euphrates Valley route, and at Bussorah we should have the facility of landing Indian auxiliaries, and of forwarding them throughout Mesopotamia and Asia Minor.

It is this power of co-operation, which would render active proceedings unnecessary, for the knowledge that the forces of England and France could be brought to bear on regions hitherto inaccessible, would alter the whole of the eastern political relationships.

Turkey, it will be seen, would be decidedly strengthened in Europe, but none the less in her great reserve of Asia. It is on the Asiatic side of the Scutari and Bussorah Railway, that the turbulent and little controlled tribes of Koords, Turkomans, Arabs, and others, are chiefly placed; these furnish little in money or in men, while they cause expense to the treasury, harrass the military forces, and prevent the settlement and cultivation of the country. By bringing strong bodies of troops to bear on insurgent or disobedient tribes, order has in all ages been alone maintained, and it is in this way that of late, the rebels of Koordistan and of Little Armenia have been reduced. The Turkish empire would be relieved from sources of expense and weakness, while the produce of the east, now unavailable, would fertilize the commerce of the west.

In the course of time, other branch lines would approach the frontiers and produce equivalent effects. Indeed, prosperity, the efficient promoter of order and civilization would be propagated throughout Asiatic Turkey, brigandage would become an ill-paying trade yielding more certain disaster than profit, and the empire would possess greater revenues, more troops, and better means of disposing of them.

We now come to a great and populous state, which, notwithstanding all our interest in it, has during this century been isolated and abandoned to the invasions of Russia, I mean—Persia. It would be worth while to make her strong, while she is yet disposed and able to maintain her independence. This will be the result of bringing her within the European system, the railway network of which, will be continued to her borders, bringing them within five days' reach of London and Paris. Within a comparatively short time, Teheran will be brought as near these capitals, as Constantinople lately was. This is no mean thing. It is, it is true, the conveyance of a letter in five or six days, but in the case of a country like Persia, it means everything which can result from admission into the sphere of western civilization. Persia is now busy with her short trial railway, and has granted concessions for a whole railway system, but bring her within a week of the capitalists of London and Paris, and it becomes possible for their trusted agents to examine, to negotiate, to receive instructions and authority, and to act effectively. Thus capital is made contributory; but, also, what is more than capital, knowledge and intelligence in the

application of European processes to native materials. To make Persia rich, to enable her to turn her own riches to her own benefit, is to make her strong at home and abroad. There are commercial interests which will induce France more readily perhaps than ourselves, to devote energy and influence to Persia; from any such operations we shall benefit.

To France, a new career of commercial and political ambition is opened more direct in its advantages than the Suez Canal, and one which binds her more strongly to her western ally. In the restoration and revival to political power of Turkey and of Persia, she must share, and she thus obtains an opportunity of asserting her position as a great power where Prussia cannot rival her; for in Turkey and in Persia, Prussia cannot as yet directly act.

The Suez Canal, interesting as that project is to France, cannot materially affect Persia, and it is only by the middle route that France can touch this newly awakened country. By the north, by the Russian railways she cannot touch it, and all that Russia does, is threatening to the political and commercial influence of France.

We see, therefore, in these various operations greater reasons for the maintenance and cementing of the western alliance, and thereby a stronger pledge for the preservation of peace; the greatest security is to be gained, however, by obtaining the means of placing the forces of the allied powers so as to protect those countries most exposed to attack.

Under such circumstances, for Russia to endeavour to coerce Turkey or Persia, would no longer be a safe proceeding, and she would have to concentrate her attention on Central Asia. At the present moment, the whole available force on 3,000 miles of exposed country, is 300,000 weak troops, to encounter the whole disposable power of Russia, assisted by naval operations on the Black and Caspian Seas, and having railway communication with the reserves on the rear. Under the combinations here described, the whole conditions may be changed by throwing into the exposed countries, 100,000 English and native troops, 100,000 French, and 200,000 Austrians; Roumania and Servia being neutralized, and the Greeks being compelled to desist from aiding the Russians or embarrassing the allies; whilst the fleets of England and France could convey to their own troops, and the contingents acting with them, the resources of their arsenals and the improved appliances of modern warfare.

Referring to some lesser results, Muskat, or Oman on the Persian Gulf, with which we have been long in alliance, and which exercises considerable influence on the coast of Mekran and the east coast of Africa, would also be brought within seven or eight days of England; and the growing trade between India and the countries of the Persian Gulf and the ports of Arabia would be promoted.

In a commercial point of view, this daily mail route, if carried out, will affect the postal correspondence of Western Europe with one quarter of the human race, will quicken the rapid development of India, and promote the revival of Asia Minor, Mesopotamia, and Persia. Politically and militarily, it will confer vigour and independence on the Empires of

Evening Meeting.

Monday, May 11th, 1868.

MAJOR-GENERAL J. T. BOILEAU, F.R.S., in the Chair.

NAMES OF MEMBERS who joined the Institution between the 4th and 11th May, 1868.

LIFE.

Brooke, Charles K., Lieut. 15th Regt. 9*l.*

ANNUAL.

Sillery, Charles, Col. late 30th Regt. 1*l.*
Stone, George H., Capt. R.A. 1*l.*
Batten, John Mount, Lt. 8th, or King's. 1*l.*

THE APPOINTMENT, AND PROMOTION OF REGIMENTAL OFFICERS.

By Colonel A. CUNINGHAM ROBERTSON, Commanding 2nd Battalion 8th or King's Regiment.

WHAT are the disadvantages and defects of the present system of the appointment and promotion of officers?

Can any better system be devised?

Supposing some other system to be better, would the advantages to be derived from adopting it be sufficient to render a change of system expedient; and, if expedient, are existing circumstances and opportunities such as to render a change practicable?

These are questions which have been frequently discussed in Parliament and by the press. Within the last thirty years they have been four times investigated and reported upon by Royal Commissions; once in 1840, again in 1854, a third time in 1857, and a fourth time in 1858.

I have no doubt that they have occasionally occupied the thoughts of most of those gentlemen whom I have this evening the honour of addressing.

The observations which I shall submit for your consideration will have reference to the two first of the three questions I have just stated.

By the question "what system of appointment and promotion is best," I understand, what system is likely to have the best effect in procuring the best class of candidates for military appointments; what the best effect in inducing the greatest proportion of those who receive commissions to devote themselves with energy and diligence to the study of military matters, and to the task of qualifying themselves for discharging, with perfect efficiency, the important and often very

best calculated to exercise a judgment. If the commercial body possesses these qualities, so do the Military and Naval Members of this Institution, and particularly the main portion of them connected with our Eastern Empire. War, when honourably directed, being but the legitimate means of securing peace, so the maintenance of peace is the most honourable distinction of the soldier; but to achieve that, he must be able to support the prestige of his own reputation by the possession of real and absolute force. It is to the demonstration of these principles, and the accomplishment of results in accordance therewith, that this memoir is devoted, and it appeals to the members on two subjects of deep and vital importance—the safeguard of our Indian Empire, and the maintenance of European peace.

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difficult duties which devolve on those Officers who are appointed to the command of regiments and of larger bodies of troops.

This is an abstract question, which may be determined by reference to general principles—to the ordinary recognised motives of human action, and to the general conditions of military service. It, therefore, seems to me perfectly suitable for discussion in this place.

On the other hand the question—Is it expedient to make a change in the existing system?—is essentially of a practical nature. It must be determined not altogether, nor even principally, by the consideration of what is desirable; but chiefly by the consideration of what is expedient and practicable. Complicated financial calculations, the possibility of conciliating or compensating adverse personal interests, and the manner in which a change of system would affect the administrative details of promotion, must all be taken into account and carefully and minutely studied, in order to determine whether the advantages expected to be derived from a change are sufficient to counterbalance the difficulties of carrying it into effect.

It is evident that the discussion of complicated practical considerations of this description, could not be profitably attempted with the time at my command, and, indeed, even if the time at my command were unlimited, could not be satisfactorily conducted without the assistance of experienced officials thoroughly versed in all the administrative details of the subject.

I therefore wish it to be clearly understood, that although I entertain a very decided and confident opinion that certain changes in our present system are exceedingly desirable, and would, if effected, produce most beneficial results, yet I am well aware that the process of effecting these changes would be a most difficult and delicate operation; it would be opposed by so many obstacles and prejudices, it would be attended by so many inconveniences, it would inflict so great an amount of injury on individual interests, and create such strong feelings of discontent, that I am by no means surprised when I find that many Officers of high rank who have studied the question thoroughly, though fully admitting the evils of the existing system, yet look upon any proposal to change it, as most inexpedient, if not, as absolutely impracticable.

I shall not attempt to examine the grounds on which this opinion rests. I shall not even venture to express any opinion of my own as to whether it is correct or incorrect. Altogether waiving this difficult practical question, but supposing for a moment that the contrary opinion shall prevail, and that on the 19th of this month, when the question is again debated, it shall be decided by Parliament, wisely or unwisely, that the present system shall be changed, I shall endeavour to explain, as briefly and as clearly as I can, what other system would, in my opinion, be the best to substitute in its place.

If I succeed in convincing you that the system I shall have the honour of explaining to you is a good system, one that would work better and be more suitable to the conditions of military service in this country than Sir Charles Trevelyan's, or than any other which has been proposed, I shall be quite contented. If any one who goes with me

thus far, say "I admit all this, but still I am not prepared to admit that these expected advantages are sufficient to compensate for the inconveniences of a change," that person has gone very nearly as far as I myself am prepared to go. It is true that my opinion inclines the other way. It appears to me that a change of system which is indubitably very desirable, though difficult, ought not to be considered impracticable. I am inclined to think that a wise and vigorous administrator, heartily supported by the influence of a strong and popular Government, if he shared my belief, would find no insuperable difficulty in effecting the change. But this is a question on which I am well aware that I am not competent to form a trustworthy opinion. I therefore beg leave altogether to decline its discussion.

The suggested changes which I shall present for your consideration I shall not venture to recommend as being practically expedient and suitable for immediate adoption, but simply as being good in the abstract, and such as, apart from all considerations of the injurious effect they might have on individual interests, would so operate as to produce beneficial results.

The most convenient way of presenting the subject for your consideration will be, in the first place, briefly to enumerate the principal evils and disadvantages of the existing system, then to submit an outline of a system which it appears to me would not only be free from those evils and disadvantages, but would also so operate as to produce results highly favourable to the efficiency of the Army; and, lastly, to endeavour to illustrate and explain the manner in which the different provisions of the scheme would operate, and the nature of the results they might be expected to produce.

The following statement of the principal objections to the purchase system, is taken from the Report of the Commissioners of 1857. I omit those objections which are founded on the injury done to the interests of individual Officers; on the hardship and injustice frequently inflicted on Officers who, from their conspicuous abilities and the distinguished services they have rendered, have the strongest claims to promotion, but are passed over because unable to purchase. I shall only notice those objections which are founded on considerations of what is hurtful to the public interests, and injurious to the efficiency of the Army:—

The purchase system, in the opinion of many of the witnesses examined by the Commissioners, impairs the efficiency of the Army, by giving an undue pre-eminence to wealth, by discouraging exertion, and by depressing merit. Under existing regulations there is little inducement for Officers to acquire proficiency in the science of war. An Officer who performs his routine duties, and who keeps a sum of money available for the purchase of promotion as opportunities offer, may look forward with confidence to the attainment of high military rank. Hence when the responsible advisers of the Crown are obliged to prepare for the contingencies of war, and to recommend her Majesty to name a Commander for her armies in the field, they must necessarily select from among Officers who have risen by purchase, and who have ob-

heir rank, not from proved capacity and acknowledged fitness, but e current of promotion, and from having been able to avail them- of opportunities of buying advancement.

country will, therefore, commence the operations of a war under vantage, as compared with those foreign states, where all the on the higher grades have been subject to several selections, y, therefore (if the power of selection has been honestly and exercised), be relied on as men of proved efficiency and superior

substance of these and of other objections are summed up by nmissioners in these words:—

he purchase system, it is said, restricts the number of those from Officers can, in the first instance, be obtained.

deadens the feelings of emulation and the eagerness to acquire knowledge.

renders men eligible for the highest command without taking urity that they are fitted for such a position.

te the words of the report, but I may mention that, for reasons I shall afterwards state, I do not attach any practical importance first of these objections.*

e is another objection not prominently indicated in the Report of nmissioners, but which appears to me to be of as great, or even , importance, than any of the three they have enumerated. To jection, as having been to a certain extent overlooked, I would special attention.

practice of promoting in the same regiment, juniors over the of seniors, and thus reversing established relations of subordi- and reciprocal obligations of command and obedience, is ex- injurious to discipline. The tendency of the practice is to non-purchasing seniors averse to exercise their authority, and er purchasing juniors impatient of control. It has also a ten- to foster in the minds of young Officers a feeling of indifference ng the careful performance of routine duties, and of something ntempt for that species of professional merit which consists in a te and minute knowledge of regimental work.

y own experience I know two Adjutants each of whom was sed over 14 times. Both these Adjutants were first-rate Officers. had trained and instructed, from the time of their joining as s until their promotion, several of the Officers who became their rs in rank.

er a system which permits such scandals as these, it is quite , and a thing to be expected, that it is not considered a disgrace Officer to be grossly ignorant of his duty, and that the instruc- the Officers of a regiment is often a much more difficult, and a more thankless task than the instruction of the non-commissioned s and privates, or (to use a somewhat different indication of the f military feeling amongst Officers) that in some regiments this Institution should not receive that amount of support which, con-

* Vide observations at p. 202.—A. C. R.

sidering the great professional interest of its objects, the admirable means it affords of promoting those objects, and the very moderate amount of the subscriptions it requires from its members, it seems fairly entitled to claim from the Officers of the Army.

Now, it is, I think, quite clear that this class of objections, viz., those which have reference not to individual interests, but to the interests of the State, cannot be obviated by substituting for the system of promotion by purchase, a system of promotion by seniority.

The system of promotion by seniority, is quite as destructive as the system of promotion by purchase, of all motives to voluntary exertion, and of all persevering and vigorous effort for the attainment of professional excellence.

The one system is quite as incapable as the other of affording any guarantee that Officers of rank shall possess the requisite natural capacity, and the requisite amount of acquired knowledge, to exercise efficiently the important functions of commanding a regiment, or larger body of troops. In point of fact, instances of manifest incompetency among Officers of rank are quite as frequently met with in the seniority service of the Royal Artillery as in the purchase services of the Guards, cavalry, and line.

Hence then we are driven to the inevitable conclusion, that the only possible mode of remedying the evils of the purchase system, is to devise some plan of comparing and testing the abilities and acquirements of each individual Officer, and of selecting those for promotion whom we have ascertained to be the most capable of performing efficiently the duties of the higher grade. The soundness of this conclusion is incontrovertible. It is admitted that it would be extremely desirable and beneficial to adopt the principle of selection according to merit, but we are told by the highest authorities that, having reference to the state of feeling in the Army, and to the social constitution of society, it is quite impossible to devise any plan of practically applying this principle which would produce satisfactory results.

Sir George Cornewall Lewis, in his speech on the motion made by Sir De Lacy Evans in May, 1862, for the abolition of promotion by purchase to the rank of Lieutenant-Colonel, said that though Lord Herbert was fully convinced that the proposed change was desirable, he was deterred from bringing forward any measure to give effect to his views because, when he came to consider the question closely, he found it was embarrassed by great difficulties of detail.

The only method of practically applying the principle of selection to the promotion of Officers, brought under the notice of the Royal Commission of 1857, and, therefore, probably the only method considered by Lord Herbert, was the French plan of committing the task of selection to the absolute discretion of the Minister of War, guided by the reports of Inspecting Generals.

His Royal Highness the Duke of Cambridge records his opinion regarding the inexpediency, or rather impracticability, of introducing this method of selection into the British Service, in the following terms :—

"My opinion is very decided that the power of selection is impos-

"sible, whether it be exercised by a military man, or whether it is to be "exercised by a civilian; and I do not think that any man having that "power would hold his position for six months in this country. Every "appointment is now so questioned and criticised that it would be "impossible to give good reasons for promoting junior men, and it "would come to seniority."

In the evidence given by Earl Grey, the same opinion is expressed. He says,—

"I am persuaded that during peace a system of selection in this "country is practically impossible. I do not believe that any Com-"mander-in-Chief or any Government would ever be able to exercise "that power of choosing officers, and they would take refuge from "attacks on the score of favouritism, to which they would be exposed "by any selection, by following blindly the system of seniority in time "of peace. The Commander-in-Chief for the time being would know "that when a lieutenant-colonelcy or a majority fell vacant, if he "appointed the next officer in succession, he would be comparatively "exempt from obloquy; but on the other hand, though he had a strong "opinion that there might be some very able officer in a junior rank, he "would not be able to prove it to the satisfaction of others, and he "would be afraid of the suspicion he would incur, and he would not "have sufficient firmness to do what perhaps the public interest required. "Under a free Government the difficulty of selection is much greater "than under an arbitrary Government. A man who has no account to "give to anybody of the principles on which his selection is made, looks "to nothing but his own judgment, and can act in a very different "manner from what can be done in this country."

Now, if no other expedient could be devised for carrying out the principle of selection, excepting that of entrusting the task of deciding respecting the relative merits of officers to individual discretion, I should certainly consider the opinions I have quoted sufficient to prove that in this country it would be practically impossible to work the principle of selection in a satisfactory way. Nor should I adopt that opinion merely out of deference to the great authority and eminent positions of the Royal Duke and of the noble Earl. The truth and force of the considerations by which their opinion is supported, cannot fail to be appreciated by every one acquainted with the feeling of the Army, and with the irresistible influence which public opinion in this country exercises over the conduct of affairs.

It appears to me, however, that these considerations which convinced Lord Grey and the Duke of Cambridge that it would be practically impossible to exercise the power of selection, do not apply to the principle of the system, but exclusively to the particular method adopted by the French, of giving practical effect to that principle.

Another method of giving effect to the principle has suggested itself to me, which is certainly simpler, which I think would be equally efficacious, and by which all the difficulties of carrying out the French method would be evaded. What I suggest is, that certain definite qualifications should be required from every officer as an essential condition of promotion. That qualified and unqualified officers should be arranged in

separate lists, and that the senior in the list of qualified officers should be selected for promotion. The qualification for promotion in the junior ranks being of a kind which none but the absolutely incompetent, or incorrigibly idle, could possibly fail to attain. On the other hand, the qualification required for promotion to the rank of field officers should be such as only allowed of its being attained by a limited number of officers distinguished by superior ability or favoured by special opportunities.

There would probably be considerable difficulty in fixing upon any qualification for promotion to the higher ranks which would be generally recognised as a satisfactory test of fitness for command; but whatever might be the nature of the qualification appointed by regulation as the condition of promotion, there would be no difficulty whatever in devising a method of ascertaining what officers possessed, and what officers did not possess, the requisite qualifications which would be regarded by every one as perfectly fair and satisfactory.

The Official entrusted with the duty of deciding respecting the qualifications of officers would not be required to exercise any arbitrary power of selection. He would only be required to exercise the functions of a judge to determine concerning a matter of fact capable of being ascertained by definite evidence. His decision would not be liable to be impugned as erroneous, either on the ground of want of discrimination, or of wilful partiality.

The following outline is intended to illustrate the manner in which a code of regulations might be framed for applying the principle of selection to the appointment and promotion of regimental officers in the method suggested :—

As regards the financial effect of the proposed regulations, it did not appear to me likely that Parliament would sanction any large grant of money for the purpose of effecting improvements in the promotion of Officers ; indeed, I do not think that, due regard being had to more urgent military objects, a large outlay for such a purpose would be justifiable. I have therefore looked upon one of the essential conditions of the problem to be, that the change of system should be effected without expense, and I have accordingly so framed my suggestions that none of them involve any addition to the army estimates.

Outline of a plan for regulating the appointment and promotion of regimental Officers :*—

I. Regimental officers to consist of three grades, subalterns, captains, and field officers.

II. Vacancies in the establishment of subalterns to be filled up in the following manner :—A certain portion, say one-fifth, to be bestowed gratuitously.

1st. On pupils of the Military Colleges, selected by competitive examination.

2nd. On non-commissioned Officers specially recommended for dis-

* This outline was first published in the "Army and Navy Gazette" 28th of March last.—A. C. R.

tinguished conduct in the field, conditionally on their passing a defined educational examination.

3rd. On non-commissioned Officers specially recommended for superior ability and efficiency, and ascertained by examination to possess the same, or nearly the same, educational qualifications as those exacted from candidates for commissions not selected from the ranks.*

The remaining vacancies (viz., four-fifths of the whole) to be given to any applicant approved of by the Commander-in-Chief conditionally on his passing a prescribed medical and educational examination, and on his paying an appointment fee of such amount as might from time to time be determined by reference to the ratio existing between applicants and vacancies—small in amount during time of war, gradually rising during the continuance of a long peace. This appointment fee to be paid unconditionally, not subject to any claim for repayment on the Officer quitting the Service.

III. Vacancies in the rank of Captain to be filled up regimentally by seniority, conditionally on the senior having passed a prescribed professional examination. All qualified subalterns, if not previously promoted to vacancies in the establishment after a certain term of service, say 12 years, to be promoted by brevet, and borne on the regimental strength as supernumerary Captains. Captains after 25 years to be permitted, and after 30 years compelled, to retire.

IV. Vacancies in the rank of Field Officers to be filled up according to their Army seniority from classified lists of Captains possessing one or more of the following special qualifications, or of such others as might be established by regulation as suitable tests of superior ability, and the possession of which should be declared as an indispensable condition to render an Officer eligible for promotion to this rank:—

a. Brevet rank conferred for distinguished service and proved capacity in the field.

b. Having been selected for the appointment of Adjutant, and having performed the duties of the appointment satisfactorily for a period of not less than three years.

c. Having obtained admission to the Staff College by competitive examination, and received on quitting it, a certificate of possessing a thorough knowledge of all the subjects embraced in the prescribed course of study.

d. Any Captain reported by the Officer commanding his regiment, recommended by the Inspecting-General, and considered by the Commander-in-Chief to have established a claim to promotion, by the ability displayed in performing some special service, or by having in any other way evinced distinguished capacity.

Qualified Captains to be divided into three classes: the first con-

* To carry out these two suggestions in a satisfactory way, it would be necessary to establish a training school for non-commissioned Officers, similar to the Staff College established for training commissioned Officers. I may state that in my opinion the effect of adopting these regulations would be to diminish, not to increase, the number of promotions from the ranks; fewer would be promoted, but these few would, in respect of intelligence and education, be equal to the generality of officers. —A. C. R.

taining all those who possess the three qualifications *a*, *b*, and *c*; the second of those who possess any two of them; and the third to consist of those who possess any one of the four qualifications *a*, *b*, *c*, and *d*. Vacancies in the rank of Field Officers to be filled, first by Captains of the first class, in the order of their army seniority; then by Captains of the second; and lastly, by Captains of the third class, their seniority to reckon from the date of their commission as Captain, not from the date of their being placed on the qualified list.

The Regimental establishment of Field Officers to consist of one Colonel and of one Lieutenant-Colonel; the Colonel, after seven years' service, or on attaining the age of 60, to retire with the rank of Brigadier-General, and on the full pay of his regimental rank; the Lieutenant-Colonel to succeed to the vacancy.

V. Exchanges to be permitted in all ranks excepting that of Colonel commanding a regiment; the Officers exchanging not being placed at the bottom of the rank to which they belong, but each taking the same place as the other occupied in their respective regiments.

VI. No restrictions to be placed on Officers accepting money as a consideration for exchanging or for retiring from the Service.

It will be observed that the proposed provisions for the appointment of Officers, although modified by important differences of detail, are in their general principles substantially the same as those of the system at present established by regulation.

It is one of the indispensable conditions of a sound military system, that in the organization of the two great classes of Officers and soldiers, the artificial distinctions of military rank should correspond with real social differences of birth and breeding; that the Officers should possess such social advantages as should render them the natural leaders of those placed under their command; that they should possess a more cultivated intelligence, purer and more delicate feelings, more refined manners, higher and more scrupulous ideas of honour and duty.

As compared with other military systems, it seems to me a peculiar excellence of the constitution of the British Army that the social relation between the Officers and soldiers, is such as to render the exercise of command easy and singularly effective. In an Army recruited by voluntary enlistment, it is obvious that the low rates of military pay can, as a general rule, only secure the services of soldiers drawn from the most destitute and ignorant classes of unskilled labourers. On the other hand, the necessity for possessing certain educational qualifications, and for paying a large sum of money as the condition of receiving a commission, are provisions which, combined with the social consideration accorded to military rank, secure for the British Army, a class of Officers so superior to soldiers in social position, that the authority conferred on the Officers by their commissions is supported by a strong moral influence exerted on the opinions and feelings of the soldiers. This produces a relation between them and their Officers extremely favourable to the successful exercise of command, and extremely favourable for inspiring the soldiers with confidence in their Officers and respect for their authority.

In the French Army, on the other hand, where the soldiers are

drawn by conscription from all ranks of the population, where many soldiers serving in the ranks are in point of birth, intelligence, and education, equal to many of the Officers under whom they are serving, it is obvious that the relation existing between the Officers and the soldiers is unfavourable to the prestige of military authority and the efficient exercise of command, that it is difficult for an Officer, unless endowed with personal qualities of a very high order, to exert a powerful influence over his men, to inspire them with confidence and respect, and to obtain from them unquestioning, willingly accorded obedience.

As to the objections which are often urged against making a money payment a condition of obtaining military rank, I think it will be found on consideration, that all reasonable objections to the purchase system apply exclusively to that part of the system which authorizes the purchase of promotion. To require the payment of a sum of money as one of the conditions of obtaining admission to the military service, and of receiving a valuable appointment from the State, is perfectly equitable in principle. Considered with reference to the interests of individuals, it does not involve the disregard of any legitimate claim. Considered with reference to the interests of the public, the right of the state to demand that a price should be paid for a first commission, is perfectly analagous to the right of a master to require that a fee should be paid by his apprentice. The Officer on whom a commission is conferred, receives as an equivalent for the purchase money paid to the state, instruction in his military duties, and admission into a service possessing many advantages and many valuable privileges.

These considerations, I think, are sufficient to establish my opinion that the demand of an appointment fee is perfectly legitimate, a demand which the state is fairly entitled to make; and I think it may be shown that what is right in principle, is also expedient in policy.

The following are the reasons which, in my opinion, render it expedient to exact an appointment fee from the majority of those who apply for commissions:—

1. To make the expenditure of a considerable sum of money one of the conditions of obtaining a commission, has obviously a tendency to restrict applicants to a class superior in social position to the class to which the majority of those belong, who are placed under the command of the Officers of the Army.

The advantages of this difference between the social position of the Officers and soldiers of an army has been already pointed out. But without denying that this is an advantage, it may be objected that it is obtained at the expense of a greater disadvantage. It may be said, and it was actually said by several of the witnesses examined by the Royal Commission of 1867, that by restricting the selection of Officers to a particular class, many persons are excluded who, by their natural endowments, are specially adapted for the military profession, and thus the average ability of the Officers will be lower than if no money qualification were exacted from applicants for commissions. I think it must be admitted that every restriction which in any degree

narrows the field of selection must to some extent operate in the manner alleged. But so long as a considerable proportion of vacancies are reserved for gratuitous distribution among specially qualified non-commissioned officers and the most distinguished pupils of the military schools, and so long as no one is permitted to purchase a commission whose fitness for the appointment has not been ascertained by an educational examination, and by other suitable tests, I do not think that this objection need be accounted of much practical importance.

2. It is a great advantage to an Army if a considerable proportion of its Officers retire from it at an early period of their service. This quickens the promotion of those who remain, and diminishes the average age of those serving in the higher ranks. Now it is obvious that the number of Officers possessing sufficient private means to enable them to retire at an early period of their service, will probably be increased much in the same ratio as the value of the appointment fee is raised, and the proportion of applicants for commissions from whom it is exacted, is increased.

3. The payment of an appointment fee, liable to forfeiture in case of inefficiency or misconduct, is a pecuniary guarantee for the ability and good conduct of every one who pays the fee.

These three advantages, more or less directly connected with the system of making payment of money one of the qualifications required from applicants for commissions, have reference to the general conditions of military service; none of the three have any special reference to the circumstances of any particular Army. In whatever Army the system were introduced, its tendency would be to secure for that Army, the three advantages I have enumerated.

There is a fourth advantage which exceeds in practical importance the value of the other three combined, and which has a special and exclusive reference to the peculiar constitution of our own Army.

By exacting from between three-fourths and four-fifths of the applicants for commissions in the Guards, cavalry and infantry, an appointment fee, not larger than could be easily obtained without checking the present demand for commissions, a fund would be formed sufficient to pay the interest of the sum required to afford compensation to any Officer who chose to avail himself of the right conferred on him by existing regulations, to retire from the Service by the sale of the commissions he has purchased. Thus means would be provided of defraying the expense of abolishing the present pernicious system of purchase of promotion, and of substituting in its place, a system of promotion by selection, without adding a single shilling to the Army estimates.

In the year 1856, the Royal Commission estimated the total sum at that time invested in the purchase of commissions, to be about seven millions. But in calculating the amount which it would be necessary to raise in order to provide compensation to Officers for withdrawing from them the right to sell their commissions, it would be necessary to deduct from this estimate the value of the commissions; firstly, of all those officers who die in the Service; and secondly, of all those who, instead of selling out, prefer retiring on full pay, or remaining in the

ervice until promoted to the rank of Major-General. These deduc-ons would probably reduce the amount by two millions or two mil-ons and a half.

On the other hand no doubt, Officers wishing to retire from the Ser-ice would claim, not only the regulation value of their commissions, ut also the amount paid by them above regulation; and it is probable, hat subject to certain limitations, equity would require that claim to be onceded. This would cause an increase, equivalent, or possibly more han equivalent, to the reduction stated above. Upon the whole, perhaps, even millions may be assumed as a tolerably near approximation to he sum that would be required for compensation, if the present system f purchase were abolished.

Now, the interest of seven millions, at $3\frac{1}{2}$ per cent., is £245,000; this um, divided by 350, the annual number of vacancies which it is sug-ested might be disposed of by purchase, would give £700 as the value f the appointment fee requisite to be paid in order to produce this sum. imagine this does not exceed what would be easily obtained in time of eace, without diminishing the number of applicants for commissions.

Of course it will be understood that I am only calculating what ould be the average price necessary to be obtained for each commis-ion—not that I mean to suggest that commissions in the Guards avalry and Infantry should be charged at the same uniform rate.

These are all the observations I have to offer concerning the ap-ointment of Officers. I now proceed to the more important and much ore difficult subject of their promotion from the lowest to the ighest regimental grade.

I shall consider separately each of the four qualifications, the pos-ession of one or other of which, I have suggested should be an indis-ensable condition to render a Captain eligible for promotion to the ank of Field Officer.

As regards the first of these qualifications, "Brevet rank conferred or distinguished service and proved capacity in the field," a very few ords will suffice.

Every one will admit that distinguished service and proved capacity the field are, beyond all comparison, the most valuable qualifications or command which an Officer can possess; indeed, there are many who think that these are the only test of fitness for command worthy o be relied on, who distrust all modes of discriminating between the egrees of merit possessed by different Officers, excepting that of com-aring the services they have actually performed in the field of battle, nd the manner in which they have conducted themselves in some ritical moment, when valour and conduct have contended successfully gainst an enemy superior in numbers, or in the means and opportu-ities of making an effective attack.

If the services of an Officer really deserve to be qualified as distin-uished, if his conduct has been such as to prove his capacity in a atisfactory way, his fitness for command and the advantage to the ervice which will be gained by his promotion, do not admit of being uestioned. In actual practice there would however be, no doubt, reat difficulty in preventing favouritism, and in rendering it tolerably

certain that the services of every Officer should be accurately appreciated, and an impartial estimate formed of their value.

Perhaps the most satisfactory way of securing an impartial award would be for General Officers to refer all recommendations, on the ground of distinguished service, to a board of Field Officers instructed strictly to investigate concerning the truth and significance of the facts reported. The report of the Board, together with the opinion of the General who convened it, might then be referred to the Commander-in-Chief for his final decision. The claims of any Officer who conceived himself neglected, or unfairly judged by his Colonel, might, on his appealing to the General, be investigated in a similar way.

Of course, whatever precautions might be taken, occasional abuses could not be altogether prevented. Cases would occasionally occur in which Officers of rank and influence would abuse the trust reposed in them, and allow motives of friendship or of interest to determine their decision in exercising the duty of selection; but I am of opinion that such abuses would be much more rare under a system where the principle was, that promotion should be regulated by merit, than under a system where it was regulated by seniority or by purchase.

Where merit as tested by the possession of certain definite qualifications was the only recognised means of obtaining promotion, any very flagrant abuse of the trust reposed in the Officer appointed to perform the duty of selection, would not be tolerated by public opinion.

The second suggested qualification is "having been selected for the "appointment of Adjutant, and satisfactorily performed its duties for a "period of three years."

In time of peace I do not think it possible to devise a better mode of selecting Officers specially fitted for the command of regiments, than to fill up vacancies from a list of old Adjutants.

An Adjutant is first picked out from a body of Officers, because he possesses certain special qualities: because he is superior to the rest in intelligence, in energy, in zeal; because he possesses a special aptitude for the conduct of business and the management of men; then he receives a special training, which makes him familiar with all the details of orderly-room work and of parade exercises. Now those natural endowments and that special training which are required to constitute an accomplished Adjutant, are the very same that are required to constitute an accomplished Commanding Officer, hence there is an evident fitness in so regulating the promotion of regimental Officers, that the two appointments should be connected; that the one should be the stepping-stone by which the other should be reached.

According to the present system, the appointment of Adjutant is left entirely to the Commanding Officer. In practice the appointment is rarely or never given to an incompetent Officer, but it not unfrequently happens, that in the selection, interest and favour prevail over merit, and that the Officer selected, though competent to perform the duties of the appointment, is by no means the most competent and deserving among the subalterns.

2. There is no limit fixed as to the time during which the appointment may be held.

3. There is no provision made for accelerating the promotion of trained Adjutants to the rank of Captain.

Now in order that a sufficient number of specially qualified and thoroughly trained Adjutants may be available to supply a large proportion of vacancies in the rank of Field Officers, three things are necessary.

1st. That the original selection of the Officer for the appointment should be made with just discrimination, and with perfect impartiality.

2nd. That the period during which the appointment is held should be limited to the time necessary for acquiring a thorough knowledge of its duties, say to three years.

3rd. That provision should be made for the immediate promotion of trained Adjutants to the rank of Captain.

Now I think these objects might be secured by the following regulations :—

1st. At each half-yearly inspection, the General should call upon each Field Officer and each Captain to report to him separately the name of the subaltern he considered best fitted to succeed to a vacancy in the appointment. The General should forward to head-quarters a list of the names reported, affixing to each, remarks expressive of his own opinion of the relative merits of the Officers. From these lists on a vacancy occurring, the Commander-in-Chief would select the Officer most favourably mentioned in the reports. When the Colonel and the majority of the other Officers agreed in recommending the same subaltern, of course all that the Commander-in-Chief would have to do, would be to confirm their selection; but when the Colonel recommended one subaltern, and the majority of the Officers another, he would probably rely on the opinion of the General. On all occasions where it seemed expedient to the Commander-in-Chief to fill up a vacancy by an Officer, not recommended by his Colonel, I think before making the appointment, it would be proper to communicate the name of the subaltern proposed to be selected, to the Colonel, and to give him an opportunity of submitting for consideration any observations or objections he might wish to offer.

2ndly. The Adjutant immediately on his appointment should take command and precedence of all subalterns; on completing his three years' term of service he should receive the brevet rank of Captain, and be borne on the regimental strength as a supernumerary, until a vacancy occurred.

I may mention that the Officers who at present hold the appointments of Adjutant and of Musketry Instructor in the battalion I have the honour to command, accepted the appointments on condition that they would resign them, after holding them for three years, and that when vacancies occur, there are other well qualified subalterns willing to accept these appointments on the same condition. I have reason to believe that by thus limiting the term for which these appointments are held, a very good effect will be produced in inducing young Officers to qualify themselves to succeed to vacancies, and I would respectfully bring the experiment I am making, to the notice of the authorities at

the Horse Guards, with the view of their considering whether it would not be beneficial to the Service to establish by regulation throughout the Army, the rule I have suggested. To permit, as is sometimes done, an Officer promoted from the ranks, and who, from his age at the time of his promotion, and from being unable to purchase, has little chance of ever obtaining command of a battalion, to hold the appointment of Adjutant for a long term of years, is in my opinion to deprive the younger Officers of a most valuable opportunity of obtaining the best possible training for fitting an Officer for the command of a battalion.

The third qualification I have suggested is, "having obtained admis-"sion to the Staff College by competitive examination, and received on "quitting it, a certificate of possessing a thorough knowledge of all the "subjects embraced in the prescribed course of study."

I fear I must not expect that all who hear me will agree with me in thinking that the possession of this qualification might, generally speaking, be accepted as a satisfactory proof that the Officer who possesses it is likely to make an efficient Commanding Officer.

The connection between the endowments necessary to pass a successful examination, and the endowments necessary to command a regiment with energy and discretion, is certainly not so obvious as is the connection between the qualities which procure an Officer, brevet rank for distinguished service in the field, or obtain for him the appointment of Adjutant, and the qualities which fit him for the command of a regiment.

It is very possible that some of the Officers I am addressing may say, the moral and intellectual qualities usually possessed by distinguished students are entirely different in kind from those usually possessed by Officers who have the reputation of having been most successful in the command of their regiments. This I admit to be true, but I reply that practically it will be found that those Officers who succeed in competitive examinations, and in attaining proficiency in the course of study prescribed at the Staff College, are, generally speaking, by no means men of those devotedly studious habits and strong natural inclination for abstract speculations which indicate peculiar aptitude for obtaining distinction as a student. They are generally men not by any means particularly addicted to studious pursuits, but merely men endowed with more than average intellectual power, and more than average energy of will, who, believing that certain acquirements are necessary to their professional advancement and efficiency, devote themselves with strenuous and persevering efforts to the studies necessary for obtaining possession of these acquirements. The moral and intellectual qualities which enable men of this stamp to excel in an examination, are, it appears to me, the very same in kind as those which are required for the successful command of a regiment.

For these reasons, I am of opinion, that the possession of this qualification is of itself, generally speaking, a sufficient proof, that he who possesses it, will make an efficient commanding officer, and that it entitles him to be considered equally eligible for promotion, as those

who possess the qualifications of brevet rank, or of three years' performance of the duties of Adjutant.

One advantage of this test, is the facility of its application, and of its being in the power of every officer who possesses the requisite ability to obtain the qualification. Even in time of war and when a corps forms part of an Army engaged in active operations, opportunities rarely present themselves for an officer to perform any distinguished service. Out of many Officers capable of achieving distinction, accident determines to whom the opportunity shall be given. Thus, although services performed are the most satisfactory of all tests of individual merit, they afford no test whatever of comparative merit, and are therefore most unsatisfactory data for carrying out a system of selection.

The test of service as an Adjutant, although it is superior to that of distinguished service in the field, inasmuch as by its mode of application, it is a satisfactory test not only of individual fitness, but of comparative degrees of merit, nevertheless has the disadvantage of being limited in its application. It might possibly happen, that for every vacancy that might occur in the Adjutancy, there might be two or more officers well qualified to fill it. This is an extreme supposition, but no doubt cases would frequently occur, where it would be extremely difficult to discriminate between the merits of two Officers of nearly equal qualifications, and where the qualifications of the disappointed Officer might rather exceed than fall short of the average qualifications of Officers who had been successful in obtaining the appointment. The examination test is free from this disadvantage; it may be applied to every officer who desires to submit to it.

But perhaps the chief advantage of including this qualification as one of the tests in a scheme of selection, is the great additional security for efficiency, which is obtained when it is combined with one of the other tests, viz.:—Distinguished service in the field, or service as an Adjutant. It is to be presumed that every officer possessing either of these qualifications, would for the sake of obtaining the precedence of a doubly qualified officer, make an effort to obtain a Staff College certificate. Thus it would happen that a large proportion of Officers selected for the command of regiments, would not only have given satisfactory proof of ability as practical soldiers, and manifested their aptitude for command, either by their conduct in the field, or by their skilful performance of the duties of Adjutant, but would also frequently possess those additional and higher qualifications which it is desirable, those should possess, who are appointed to the command of large bodies of troops. They would be officers who possessed a competent knowledge of military history, and of the theoretical principles of the art of war; who were accomplished in all arts, sciences, and acquirements, applicable to the conduct of the offensive and defensive operations of war.

The 4th of the proposed qualifications, is "having displayed ability in performing some special service."

This provision is intended to meet exceptional cases of rare occurrence—such as courage and ability displayed on occasions of ship-

wreck, fire, pestilence, mutinies, civil disturbances, conduct of difficult marches, &c.

The same precautions might be taken to guard against abuses, by appointing a board to report on such recommendations as were suggested, to guard against abuses in recommendations for brevet promotion.

Suggestion V. "To permit exchanges in all ranks (excepting that of Colonel [commanding a regiment), each Officer to take the same place in the list of the Officers of his own rank as the other occupied," and

Suggestion VI. "To remove all restrictions on officers accepting money," are intended as provisions for promoting early retirements, thereby accelerating promotion, and conciliating personal interests. For the sake of still further promoting these important objects, I would recommend the permission, not only of regimental exchanges between Officers of the same rank, serving in different regiments, but also changes of position between Captains on the same classified list of Officers eligible for promotion to the rank of Field Officers. The manner in which, I think such arrangements should be carried out, is this: an Officer wishing to retire, or to exchange, conditionally on his receiving a certain sum of money, should make an application to the Adjutant-General, stating the terms he was willing to accept, and accompanied by the usual certificates that the application did not originate either in inefficiency or misconduct. If approved of, the application would be published in orders, and tenders invited for the money demanded. Subject to any discretionary power of selection, which it might be thought desirable to entrust to the Commander-in-Chief, in the case of an exchange, the offer of the senior Officer tendering the required sum would be accepted; in the case of a retirement as soon as the required sum was lodged, the senior in succession would be promoted. One or two illustrations will show how these provisions would work. First as regards retirements: suppose the Colonel commanding a regiment wanted to retire, it would be the interest of the regimental Lieutenant-Colonel, and of the Captain at the head of the list of those eligible for promotion, and of the senior subaltern of the regiment, to which the Captain next for promotion belonged, to make up the required sum. In the same way, if a Lieutenant-Colonel wished to retire, it would be the interest of the qualified Captains, and of the regimental subaltern next in succession to make up the required sum. The retirement of a Captain would, as at present, be a purely regimental arrangement, the only officers interested in the step being the subalterns of the regiment to which he belonged. In the event, however, of the subalterns being unable or unwilling to raise the sum required to secure the step, the proposed regulation respecting exchanges would afford a Captain the means of making arrangements with officers of other regiments for obtaining the sum he had fixed as the condition of his retirement. In the first place, if holding a good position on the list of Captains eligible for promotion, he might find an officer low down on the list willing to give the required sum for an exchange of positions; or, secondly, if he belonged to the list of un-

qualified Captains, it might be the interest of a qualified subaltern in another corps to induce the senior Lieutenant to exchange, and having effected the exchange to obtain his promotion by paying the sum required by the Captain desirous of retiring.

These suggestions for accelerating retirements are, I am aware, open to some objections, similar in principle, but by no means similar in their practical bearing to objections which apply to the purchase system. My suggestions are not proposed as faultless in principle, but as the best practical means I can devise of providing an inducement for early retirements sufficient to ensure such a proportion of these retirements as is indispensable to the successful working in time of peace of any system of promotion whatever.

The only other alternative that I can see, is to fix a short limit for the period of an officer's service in each rank, and to render the retirement of all who reach this limit compulsory; of course the adoption of this alternative would involve a very large expenditure for retiring allowances.

To prevent misapprehension, it may be well to point out the very great difference in its practical working between a system which recognises "*a right to purchase promotion*," and a system which does not recognise that right, but which "*grants permission to Officers of the same rank and in the same list as regards qualification for promotion to exchange positions.*"

The effects of a right to purchase are—

1st. That an Officer who cannot purchase may be superseded an indefinite number of times by the promotion of his juniors, without being brought a single step nearer the top of his rank.

2nd. That when he does become senior of his rank, an indefinite number of vacancies may occur in the ranks above him, to none of which the rules of the service permit him to succeed.

3rd. That all supersessions are regimental, and that consequently actually existing relations of military subordination and actually existing reciprocal obligations of command and obedience are reversed in a manner most injurious to the interests of discipline, and most hurtful to the feelings of the superseded Officers.

The suggested permission of Officers of different regiments to exchange positions, would produce none of these injurious effects:—

1st. An exchange of position between two Officers of different regiments does not affect the position of any other officer of the same rank, or in any way lessen his chances of promotion.

Whatever number of exchanges may occur among his seniors, each vacancy that occurs in the upper ranks, brings the junior officer of the rank below, one nearer to the top of the list, and when he becomes senior of his rank, if properly qualified, he succeeds to the next vacancy that occurs.

The effect of each exchange is merely to substitute one individual for another among his seniors. However numerous such exchanges may be, they do not increase the number of steps necessary to bring the junior to the top of the list, or in any way obstruct the effect of each vacancy as it occurs in the rank above, raising him a step on the

list, and thus contributing, exactly in the same manner, to his advancement as if no exchanges had taken place among those above him.

2nd. Although it might happen that an Officer exchanging positions was junior in the service to some of those placed below him in the regiment into which he exchanges, yet this supersession would reverse no previously subsisting personal relations and, therefore, would not inflict any injury on discipline by the reversal of reciprocal duties, and of the established order of regimental subordination. The case would be much the same as when a young Captain, under the present system, exchanges into a regiment where many of the subalterns are much senior to him in the service. This supersession is not so injurious to the interests of discipline, nor is it so hurtful to the feelings of individuals as when a young subaltern purchases his company over the heads of his seniors.

It is obvious that one of the effects of establishing a system of promotion by selection, would be to render those Officers anxious to retire from the service who failed to obtain the qualifications necessary for promotion. As compared with the present system the effect of the proposed system would therefore, I think, be both to increase the motives and to increase the facilities for early retirements.

If this anticipation were realized, two great advantages would be obtained:—

1. The average age of officers would be diminished.

2. The country would be relieved from the obligation of compensating officers for any sums they might have expended in excess of the regulation prices of their commissions, and the sum required for this purpose would, therefore, be reduced from seven to probably not more than five millions.

Having now explained the manner in which I imagine the different changes I have suggested would work, I shall conclude by briefly stating the advantages which I believe would result from substituting the proposed system of appointment and promotion, for that at present established by regulation:—

1. A powerful motive would be given to induce officers to exert themselves to excel in their profession, which motive to a greater or less extent, during the early period of their service, would operate on every officer without exception.

2. As the result of this stimulus to exertion, the average amount of acquirements, and of the professional ability of the officers of the Army, might be expected to be considerably augmented.

3. All officers appointed to the command of regiments would be picked men; in every case officers of proved ability, and in most cases, men not only of superior natural capacity, but also of superior professional acquirements.

4. The command of a regiment would be attained at a much earlier age than it is at present.

5. Officers of inferior capacity would have stronger motives for retiring from the Service than they have under the present system, and the facility of effecting early retirements would probably be found to be greater than it is at present.

6. The pernicious practice of purchasing promotion would be abolished without any charge whatever being made against the public revenue on account of the seven or five millions necessary to be provided for compensating officers for the money expended in the purchase of their commissions.

In making this comparison, the existing system to which I referred was, of course, the purchase system, which regulates the appointment and promotion of officers in the household troops, cavalry, and infantry of the line, but I wish to take this opportunity of stating a very strong, and I trust a well considered opinion, that whatever advantages in point of efficiency would be gained by substituting in these branches of the service a system of promotion by selection for the system of promotion by purchase, the same advantages in a still higher degree would be gained by substituting in the artillery branch of the service, promotion by selection for promotion by seniority.

It seems to me absolutely essential, both to the general efficiency of this most important branch of the Service, and also to the individual interests of the Officers composing it, that whatever be the system of promotion adopted for the other branches of the Service, the same system should be established in the artillery.

The great difference in the rate of promotion, and in the average age of Officers, which now exists between the artillery and the line does not altogether depend on the difference between the effect of the principle of seniority and the principle of purchase. In a great measure it depends upon these two different systems being brought into competition in the same Army.

If seniority were the regulating principle of promotion in all branches of the Service, no doubt promotion would be slower in all of them than it now is in the cavalry or infantry, but in none of them would it be so slow as it is in the artillery, working under the condition of being brought into competition with the purchase system.

The effect of this competition is, that the whole of that class of Officers who retire from the Army after short periods of service are attracted to the cavalry and line, and that, almost without exception, those Officers who enter the artillery belong to a class who complete their full term of service before they retire.

Now, if the system of promotion were the same in all branches of the service, the distribution of the class of Officers who retire early, would be very different. The proportion attracted to the artillery would, from the natural advantages of this branch of the Service, be greater than that attracted to the line, and the rate of promotion in the two services would undergo a corresponding change; that of the artillery would be accelerated, that of the line diminished.

Perhaps it may be objected that the Officers who retire early, generally feel little interest in their duties, and no interest at all in scientific pursuits, and are, therefore, quite unfit for the artillery service. But I think it a fallacy to suppose that Officers who belong to this class, generally speaking, feel less interest in their duties than those of the class who devote their lives to the service. Young, energetic men make good Officers, and perform their duties zealously, whether they

intend to remain 10 or 50 years in the Service. I think it a still greater fallacy to suppose that, as an actual matter of fact, the majority of Artillery Officers are men of scientific tastes, or to suppose that if the majority of the Officers could really be imbued with such tastes, their practical efficiency and capacity for performing their duties, either in quarters or in the field, would be materially increased. The art of fighting guns is a matter of rule and practice which is easily acquired by any intelligent Officer. In the junior ranks of the Service, courage, energy, intelligence, presence of mind, and practical experience, are much more essential to the successful working of a battery in the field than high scientific attainments. As there are many skilful navigators who know little or nothing of the science of astronomy, so I hope it is no libel on a body not less distinguished for scientific attainments than for conspicuous gallantry, to say that there are many excellent Artillery Officers who are very indifferent mathematicians, and anything but proficient in the theory of projectiles.

I feel convinced that by making the appointment to the majority of vacancies in the artillery dependent on the payment of a fee, and by making the possession of certain prescribed qualifications an essential condition of promotion to the rank of Field Officer, not only would the rate of promotion be increased, and the general efficiency of this branch of the Service improved in a corresponding ratio, but that the average qualifications of the Officers in respect of scientific attainments would be raised, and that the number of Officers eminent for their complete mastery of the whole science of artillery would be even greater than it now is.

Colonel Ponsonby, Grenadier Guards: Colonel Robertson has told us that he is against promotion by seniority and against promotion by purchase. I cannot help thinking, that if he allows commissions to be sold at their market price, that will be introducing a new system of promotion by purchase. Instead of being purchase by regulation, it will be purchase for anything that Officers can get. I do not exactly see how the two will work together—how the promotion by selection and the promotion by purchase will ever be able to work together. The Colonel of a regiment who finds himself near the end of his period of service, will make his bargain with the senior Officers of each rank; and, of course, each Officer, probably, would sell out according as the time came. That I think would be another system of promotion by purchase. Some of the points in connection with promotion by selection are well worthy of consideration; and, particularly that about the Adjutant. I am not quite sure that three years is long enough; I should have thought five years would be better. But Colonel Robertson, I admit, has had more practical experience than I have had.

Colonel Robertson: You would not have a sufficient supply unless you shortened the period.

Colonel Ponsonby: That is true.

Sir Charles Trevelyan, K.C.B.: I have been attracted here this evening by the extreme interest of the subject before the meeting, and I have not been disappointed. We have heard some very valuable observations. I am especially pleased to see that Colonel Robertson has not been afraid of introducing to a great extent the element of selection in promotion. He has laid down some excellent rules, which must form the foundation of any system that hereafter may be adopted in consequence of the abolition of the system of purchase. It must be observed that Colonel Robertson's argument assumes the abolition of purchase. It assumes that the country will consent to pay a large sum in compensation to Officers, not

only for what they have invested in their commissions according to the regulation price, but for those extra prices which have been paid according to the custom of the Army, and with the full knowledge of the authorities. It also assumes that Parliament will provide a system of retirement at the public expense in the place of the system of retirement by purchase, which is really at the expense of the Officers themselves. It also assumes that, as the Army is to be more than ever a professional Army, professional rates of pay will be given in substitution for the present obsolete and totally inadequate rates. As the country will make these great sacrifices, of course it will expect to obtain value for its money: it will expect that not only those changes will be made which are necessary for the perfect efficiency of the Army, but also those which are required to be made, in order to make it an open career for every class of our population, and to make it a national training school of the utmost possible value. In order to make any useful observations, it would perhaps not be advisable for me to take particular points, but as briefly as I can to take a general view, founded upon Colonel Robertson's plan. Everybody will admit that the Army must, in the main, be officered from the upper class of society. The upper class is the most highly educated class. From their position in the social scale they are formed to habits of command, accustomed to command from their earliest childhood. The classes below them are accustomed to submit to their authority, and the upper classes are the special depository of the traditions of Christian chivalry which inculcate truthfulness and personal honour, and all the high moral qualities which belong to the character of the gentleman. But security must be taken that the superior education, which is the special recommendation of this class, really exists; in short, that the country obtains the services not only of members of that class, but of worthy members of it; of those who have prepared themselves for the important duty of commanding their fellow-men, and having in trust their happiness, their prospects in this life, and, as a Christian gentleman, I must say, in a high degree, their eternal prospects. I do not know any opinion which is so generally accepted, especially by experienced military men, as that our public schools, in which I include not merely the old public schools, Eton, Harrow, Rugby, and Westminster, but a very large number of proprietary schools and colleges which have arisen in various parts of the country on the model of those old public schools—it is admitted—it is no longer open to argument, as will be seen, on reading the evidence given before the Purchase Commission, by Officer after Officer, with Lord Clyde at their head, that our public schools are the true nurseries for the Officers of our Army. Not so much for the book learning that is obtained there, as for the moral training; the knowledge of character, of life, and manners; the acquiring in the beginning of life, habits of obedience and of command; and the high and honourable tone prevailing, for in all these schools, as most of us can say from our own personal experience, there is a prevailing public opinion which on all main points is of a highly honourable and manly character. For this purpose, in order to obtain a full school education, in order that the young men may not be obliged to leave school prematurely, and with the name of having been at a public school, may yet fail to obtain the benefits of a public school—for we all know that the greatest benefits are reaped in the higher forms—the age for entering upon the military profession should be fixed, so as to allow them to pass through the sixth form, I should say, not under the age of 18. That completes the general education of the young men. Then comes the special education. In every other profession it is considered necessary that the candidate should undergo a preliminary professional training. Why not in the Army? Is it not more necessary than ever in the Army? The Army is eminently a profession; it has its science. It has its history, and its science. All the manœuvres, evolutions, and tactics are eminently scientific, and require a previous training. Therefore, in my opinion, every young man who has finished his general education and is intended for the Army should go through a course of special professional instruction in a military college. The admission to the military college, as proposed by Colonel Robertson, should be by competitive examination. But on this point great care must be taken so to arrange the examination as to exclude that most pernicious system of "cramming," which has grown up outside our public schools. The true mode of discouraging "cramming"

was that which was pointed out by Lord Macaulay in reference to the competitive examinations for the Indian Civil Service, namely, to exclude from the examinations every obligatory attainment, not only everything that is technical, but every obligatory attainment; to examine the young men in what they may have happened to learn, whether it be classics, or mathematics, or foreign languages, or natural science, or whatever it may be, provided it fairly comes up to the idea of a liberal education. If the young men are examined in what they know, not in what they are required to go out of the way to learn, the occasion for cramming disappears—it cannot arise. That plan has been followed by the Civil Service Commissioners with great success. Then every step of these young men's progress in this military course will be of the nature of probation. There will be two distinct objects in the military college. One will be to make it a probation, so that those who have mistaken their profession, who have not the self-control, or the good principle, or the natural capacity to enable them to pursue it with advantage may be weeded out, and may not be left to enter the Army, and then to be got rid of, to the disadvantage not only of the public service but of themselves. Of course, the rudiments of the military profession should be taught there: military science, surveying, military history, and so forth, with drill and military discipline. Every young man leaving a military college should at least be able to put a company through its manœuvres, so that when he joins his regiment he may teach his men, and not have to be taught and drilled by his men. In fact, he should join his regiment fully prepared to enter at once on the effective discharge of his duties. If these great advantages, of a free commission, of pay sufficient to enable him to live by his profession, with retirement at the public expense, are given him, the public has a right to expect that there shall be no waste, and that the young men shall commence at once, after they join their regiments, to do effective public duty. With every respect for Colonel Robertson's opinions, I must say that I entirely differ from him as to requiring a previous payment. It involves a logical absurdity, to increase the pay of the young men, or even to give the present pay, inadequate as it is, with one hand, and then to take it away with the other. It will not stand the test of real examination. And it is very undesirable that a young man should enter a profession, especially the Army, burdened with pecuniary obligations. It is an essential condition of efficient service in any profession that a man should be able to live by that profession. Then we all know that the most valuable class of young men in all professions, in the law, the church, in civil engineering, and in every other profession except the Army, are the young men who have not capital in money, whose capital is only in their character, their industry, and their attainments. Who are the men who rise to be Lord Chancellors and to all the high offices in the law and the church? They are not young men of fortune. They are young men who have lived laborious days, who work hard, and have only their education, their training, their ability, their industry, perseverance, and patience, to depend upon. Now, any payment, however small, has a strong tendency to exclude that most valuable class of young men. I now come to the other great source of providing Officers, the other great element, namely, the promotion of non-Commissioned Officers to be Officers. This will draw persons of all classes into the Army, adding to its other great attractions that of making it an open career by which competence and distinction may be attained. At present only the highest and the lowest classes of our population are represented in the Army. The Officers represent the highest stratum of society; the soldiers represent the lowest stratum. But since that model was fixed for our Army at the Restoration, the bad political and moral time of the Restoration, English society has developed in an extraordinary manner. In the last 50 years, within my own recollection, it has made extraordinary progress. It is difficult to describe it. Look at the multiplication of employments—railways, manufactures, mercantile business (mercantile business in my youth was not one-twentieth part of what it is now), colonies, civil engineering, India—so many employments which occupy our energetic middle class, that class which has had the largest share in making our country what it is. Education has also greatly developed; national education, popular education, has spread far and wide throughout the country. The improvement in middle-class education is, more especially, a sign of the times—so that the classes

between the highest class, now represented by our Officers, and the lowest class, represented by the rank and file, are immensely developed. Numerically they are the most important; in industry and intelligence they are far the most important. And why should not this great middle portion of our people be represented in the Army? Why should not the Army be a true representation of our nation? We see how Austria went down before Prussia. The main cause of that was that the Prussian nation was in their Army; every class was represented there. It was not so in Austria. And again in France every portion of the population, through the system of conscription, is represented in the Army. There that great end is obtained through conscription. Here we may equally attain it through our voluntary system, provided we make the Army an open career for all classes of our population. See the admirable result which would follow this great change! how the intelligence and *morale* of our Army would rise. The *morale* of the Army would be pitched at the standard, not of the lowest class, as it is now—I mean the rank and file, including, as it does, too large a portion of the scum of society—but of the intelligent middle class. See the immediate consequences of such a change; and these are only part of what may be expected. Our pothouse system of recruiting would be at an end. The Army at present is the sole instance of a line of life which does not furnish a provision for life, which furnishes no career, no means of rising, no means of satisfying that natural craving which God has implanted in the breasts of men for improving their condition. Why should the Army be the only line of English life which is deprived of that great motive? When that is set right, and when the British Army has become a place for the whole British nation, then the recruiting difficulty will be got over. Bounties will be no longer required. It will be a privilege to be admitted into the Army, and a punishment to be dismissed from it. The recruiting staff may be largely diminished; in fact, altogether dispensed with. Instead of our touting in the public-houses, sweeping the public-houses for the off-scouring of our youth, the best of them will come to us and ask as a privilege to be admitted into the Army, as they do now to be admitted into the police. As for flogging, there would be no occasion for it; and those large establishments, the military prisons, with the great expense attending such establishments, and keeping the prisoners, the escorts, and all the other arrangements, we shall hear very little of them, because an effective punishment, the only effective one, will be dismissal from the Army. But I fear that I am trespassing upon the patience of the meeting.

The CHAIRMAN: Not if your further observations are not very long; the time is passing by, and perhaps some other gentlemen may wish to give us their views.

Sir CHARLES TREVELYAN: I shall pass very rapidly over the rest of what I have to say. The Army will thus be made a profession for the whole population; the military authorities would have a much wider selection. Instead of selecting from one class only, they would select for the ranks of non-Commissioned and Commissioned Officers from the whole of our population. That strong native undersoil, which the Bishop of Lichfield alluded to the other day, would be largely turned up, and the nation would have the benefit of it; the opportunities and facilities for selection would be perfect. No competitive examination, in fact no examination at all, would be necessary, except to see that the persons promoted had the requisite education, because examinations, after all, are a make-shift, they are a substitute for the real thing. The real thing is to have the man before you performing his duties, so that you see him in his whole character and conduct, and see whether he possesses those high qualifications which are requisite for promotion; the practical result would be much as it is in the Prussian Army, where candidates are promoted from the ranks, but only after they have been approved of by the whole body of Officers of the regiment, because, although the responsibility of making promotions would rest upon the Commanding Officer, he would be very much influenced by the recommendation of the Officers of the regiment. There could be no mistake, because there would be no uncertainty; they would know the whole man; he would be entirely before them. The regimental schools should be greatly improved so as to give the non-Commissioned Officers and privates, facilities for studying their profession and qualifying themselves for promotion. And, in my opinion, though it is no suggestion of mine,

—it is suggested by a much higher authority than I am—a Captain Instructor who has passed at the Staff College, should be appointed to each regiment to guide and assist the studies of both Officers and men, and, of course, to superintend the regimental school. I would observe, with reference to a suggestion of Colonel Robertson's, that great caution should be observed in admitting "distinguished service in the field" in the case of a non-Commissioned Officer or private as a ground for promotion, because the question now is, fitness for bearing Her Majesty's Commission. A soldier may perform an act of great daring, and yet may be the last person qualified to be promoted to a commission; it would be injurious to the public service and also to him that he should be so promoted. It would be far better to reward him in some other way. The result at which we have arrived is, that we should have two classes of Officers; the distinguishing feature of one class would be superior education, of the other, practical experience. Those two elements properly manipulated would combine every practicable security for proper qualification. There is no room for any third class; if introduced, it must be wanting in some of the requisite conditions of efficiency. All that now remains is, to determine in what proportion the Officers shall be composed of those two elements. The larger proportion of commissions should be assigned to the candidates from the military colleges, because, first, the predominance should be secured to superior intellect and education; and, secondly, while Officers promoted from the ranks would generally follow their profession to the close, many of those admitted from the military colleges would enter the Army only for a few years, as they do at present. I hope that habit of our young men of fortune serving for a few years in the Army will never cease. So that, whatever the proportions of the two classes might be at first, they would be likely to be altered in the end in favour of those promoted from the ranks. Therefore, the proportion of those promoted from the ranks should be less than of those who come from the military colleges. The French system of promotion is, that one-third of the appointments to commissions is given to *sous-officiers*. The Prussian, Austrian, and Russian systems are that young men of family and liberal education descend into the ranks and serve as privates with a view to early promotion as Officers, performing all the duties of privates and being promoted to be Non-commissioned Officers, but only associating with the men in the ranks more or less according to their education and personal habits. Of those two I think the French system is greatly to be preferred, because it opens the military career to the whole nation; because it gives a greater choice; because it produces Officers of greater military experience. In fact, it is the difference between taking a small class who are sent into the ranks to learn their business, and taking the whole body of the rank and file and non-Commissioned Officers, and selecting the best among them. I now come to the subject of promotion, on which I will only make two or three observations. In my opinion there should only be four ranks of Officers below the general Officers—two company—Lieutenants and Captains—and two field—Lieutenant-Colonels and Colonels. Whatever the reasons may have been for having six ranks originally, I think they no longer exist. It is very desirable that the system should be simplified; a host of difficulties would be got rid of by doing so. The two field ranks, in my opinion, should also be Army ranks, as they are in all other Armies. The British Army is the only Army in which the field ranks are merely regimental ranks. Then up to the rank of Captain the rule of promotion should be seniority—tested by examination, and qualified by selection—modified by selection. The examination would be first, the practical professional examination which is constantly going on through the Inspecting General Officers, which, of course, is of the utmost value. In the French service the promotions are made yearly upon that examination combined with the reports of the regimental Commanding Officers. I conceive that after a young man has been a few years in his regiment, under the observation of his Commanding Officer, and he has been reported upon by several Inspecting Officers, he becomes thoroughly known, and, as he rises, his fitness for command becomes more fully known, so that really there can be no mistake at all. The other examination would be in professional science, previous to his attaining the rank of Captain. Then those supplementary tests pointed out by Colonel Robertson—the Adjutancy, the

Staff College, and "special services"—are of the utmost value, and, of course, would come largely into consideration. Lastly, I would only observe that I am against the modified system of purchase proposed by Colonel Robertson. To allow of exchanges by purchase, in which the new principle would be introduced, of the Officer purchasing, actually taking the place of the Officer with whom he exchanges, would be returning to the old purchase system in a more objectionable form. It would be purchasing over the heads of any number of Officers, and merely by money an Officer might get on as fast as he does now, indeed I think faster. I think an absolute prohibition ought to be placed on Officers accepting money as a consideration for exchange or retiring from the Service, because although, undoubtedly, the worst part of the present purchase system is the purchase of promotion, yet the bonus system, as it is called, is also open to great objection. I will read a sentence from a letter which entirely expresses my experience and opinion. I will not say whose it is, it will speak for itself:—"This (that is the bonus system) is to re-introduce purchase in a form which, to my mind, has little more to recommend it than "what you wish to displace. It is, of course, the interest of old Officers to encourage "such notions, but, practically, they, the first recipients of such bonuses, are the "only persons who profit, all those who come after, being merely in the position of "recovering the sums they had previously spent in the subscription. I think every "possible official discouragement should be thrown on such schemes, while we "should not cease to suggest the expediency of enforcing retirement according to "certain scales of pay, rank, and age." The result would be, as it was in the Indian Army, to overburden the Officers with debt with no earthly advantage, because, as has been said, they only recover money which they had previously laid out, and the retirement would be just as quick if they kept their money in their pockets or invested it in the funds. Let officers retire according to their respective plans of life, and let the Government aid, by the grant of suitable retired allowances. I trust that you will pardon me for trespassing so long upon your attention.

Captain Mitchell, R.M.: It is with diffidence that I venture, in the presence of so many my seniors, to make one or two remarks. With regard to the second suggestion of Colonel Robertson, the increase of educational qualifications in non-commissioned Officers recommended for promotion, it appears to me that at present the practical effects would be to select from non-Commissioned Officers those who are least fitted to command men. Everybody who has any experience in the service knows, that many young men of good education join the Army as a last resource, who are not the good soldiers that educated men are in other armies. If this suggestion of Colonel Robertson were carried out, they would be the very men who would take advantage of these educational qualifications; but of course there could be other tests. With regard to the French system of one-third choice and two-thirds seniority, I know that in that service it excites a great deal of bad feeling; although it is kept under by various means which we could not possibly employ in our service. I think the choice of Officers, even under the restrictions which Colonel Robertson has assigned to it, would be an exceedingly difficult thing, and an exceedingly invidious thing for any Officer to exercise. With regard to the qualifications for the promotion of Officers, three of the four qualifications given, are very good in themselves. There are, however, many very good Officers in the service who possibly could not come under any of those heads. It is not possible for everybody to perform "distinguished service in the field." There may be many very good subalterns in a regiment, and yet only one of them, probably, can have the opportunity of performing the duty of Adjutant. The Staff College is a thing that seems to me only available for the few, rather than for the many. I pass over the term that Colonel Robertson suggests a Colonel should be permitted to retain command of a regiment, and I come to the question of exchanges "permitted in all ranks." I do not know whether Colonel Robertson combines that with the system of selection for promotion above the rank of Captain. If he does not, I would suggest that it would be a very great hardship on an Officer who is second for field officer's rank, to allow an Officer who has just been promoted to the rank of captain, to exchange with the Officer who is senior in the regiment, and so pass over an Officer who is very much his senior. I have not touched on the purchase question as I belong to a non-purchase corps.

General Sir William Codrington, G.C.B.: There is no doubt that the questions that have been mooted are very important; and one result of the discussion on Colonel Robertson's plan, has been the introduction, by Sir Charles Trevelyan, of the great question of purchase or non-purchase. The great point in our Army as far as my experience goes, is the regimental system, namely, that an Officer entering a regiment, hopes to get to the command of that regiment by fair and direct promotion. If there is to be this selection spoken of, it will be a very difficult thing for any committee to decide about the comparative merits of the Officers of a regiment of which they form part. If I recollect right, on the question of selecting Commanding Officers, that is to say, from the rank of major, who was to be a Commanding Officer, the Commander-in-Chief himself, the Duke of Cambridge, declined being responsible for the selection of Officers for that post, from its being a very difficult thing for him to judge of. I think it would be a very difficult thing for Officers in a regiment to put their finger, not only upon the merits, but upon the demerits, that is to say the comparative demerits of other Officers, whom they reject for promotion by putting a junior Officer over their heads. That is one of the most difficult points. All Officers, I think, feel that it is the regimental system that has kept us very much together. An Officer enters a regiment, he feels while he is there, that it is his home: he hopes to get on to command a company; he hopes to get up to be major of that regiment; he hopes to command it; and in many cases to die in the regiment. Well, if there is to be this selection, this changing from one regiment to another by selection, I say it is a very difficult point, and one, I think, that will be scarcely practicable. And here comes the point: Look to the foundation of our English Officer, what is he? He belongs peculiarly to the class of the gentry of England. Independently of his position as an Officer, he is in social position, a gentleman. He is not only to be received in society as a gentleman, but by the Mutiny Act he is a gentleman; therefore, he can be called upon, either as a matter of social business, or as a matter of positive law, to act as a gentleman. Now, without going into the question of the comparative merits of private soldiers and non-Commissioned Officers, I put it clearly, is it not a very difficult thing for a private soldier, who must get to a certain length of service, and a certain rank by that service, before he becomes a commissioned Officer, to enter at once into the social position that is required by Act of Parliament, independently of the social feeling? That is the great difficulty which I think those ignore, who wish to introduce the middle classes of the country into a profession that is not remunerative in a money point of view, but which is partly so by honour, and the Officers of which should feel that it is better to be thus remunerated.

We must now come to consider what are the general motives which influence the classes whom it is sought to introduce into the Army as Commissioned Officers. First of all, we will begin with the private soldier. Why is it that we have lately received as many recruits as we want? Because we have increased the pay of the Army to a certain point, so as to induce them to come in. They find it is better worth their while; and we must feel that to a certain extent it is a question of payment. We will next take the non-Commissioned Officer. What is the inducement to the non-Commissioned Officer to enter the ranks as a private soldier, with the hope of becoming first a non-Commissioned, and then a Commissioned Officer? I will compare his position with other positions in life. It is perfectly true, as Sir Charles Trevelyan has said, that there has been an enormous advance made in the application of the talent of England,—to what? To the colonies, to engineering, and to all sorts of occupations giving great remuneration,—wide fields for employment and great remuneration. Now, a private soldier has 1*s.* 2*d.* a day; a corporal has 1*s.* 7*d.* Now I would just ask any one, taking the really talented class to which reference has been made, who can put their children as apprentices to engineering, or to the various other employments of life, whether they would be willing to come into the Army for the sake of 1*s.* 7*d.* a day to do the duties of corporal? What are the duties of the corporal and private soldier in our Army, of whom two-thirds are employed in the colonies? Mounting guard, cleaning belts, and other excessively irksome duties. What is the inducement for them to come? There is the real difficulty that I think Sir Charles Trevelyan has not seen, in a mercantile country like England, where there is an immense field for the working classes, both at home

and in the colonies. I do not see why those classes should come into the Army. Now as to the non-Commissioned Officer. He has come to be a corporal, a sergeant, and this after a certain term of service in which he has spent the best part of his life. Say he then becomes a Commissioned Officer. What is his pay? As ensign, it is £80 a-year, scarcely enough to pay for his positive expenses. How are we to suppose that a non-Commissioned Officer is then to enter really into the spirit of his new position in the Army? He may have married in a different class of life, and a thousand things of that kind may interfere socially with his position. I have known, and I will be bound to say that many Officers have known, non-Commissioned Officers who have come to be Sergeant-majors and then Officers, who have wished themselves non-Commissioned Officers again. Why? Because their half-pay was positively not so much as the pension they would have got; and they were put in that position in which they were obliged to be socially higher, and yet not able to support their rank. These are the practical difficulties which I think every Officer in the Army must feel. We now come to another point. The question of purchase which has been mentioned is a question upon which there is a great difference of opinion. Even those who have been non-purchasing Officers have felt that they have had very frequently great advantages from the rapid run of promotion that has taken place, bringing them up to the head of the list. Of that there is no doubt. We must also consider this, what is the class you want for Officers in England? The Officers of the English Army have now, from various causes, a certain feeling of independence. This may be occasionally inconvenient as to discipline, but it is of national value. Although in a separate profession, paid by the State, and whilst keeping themselves free from State politics or from State discussions, they feel that they need not give up that feeling of independence appertaining to the class of English gentry from which they spring. I look upon that, in a constitutional point of view, as a very great advantage to the country, to have the Officers of the Army in this position. These are things that are incidental to the position of the Officer, as a gentleman. It is a very great object, and it is valued by the men and the non-Commissioned Officers, that the Officers should come from that class, that you should be able to insist upon their being not only Officers, but gentlemen, to whom the men and non-Commissioned Officers can look up.

The CHAIRMAN: If no other gentleman has any observations to make, I will now call upon Colonel Robertson to favour us with a reply.

Colonel ROBERTSON: I would only say, in reply to Sir Charles Trevelyan, that in constructing my plan I mentioned that there was to be no increase of expense. Now, Sir Charles, I observe, takes it for granted that the country is prepared not only to pay a very large sum in the way of compensation, but to increase the pay of the Officers of the Army. If the Chancellor of the Exchequer were to put so large a sum at my disposal, I do not think I should adopt Sir Charles's scheme, nor should I adopt my own; my scheme, however, should be judged of as one that does not involve one shilling of expense. As to these exchanges which many gentlemen have objected to, I do not like them myself. If you can give unlimited retiring allowances and compulsory retirement you will secure promotion without exchanges. But I think that the system of exchanges is better than the system of purchase; I think they are objectionable, but as I do not think there is any chance of the Chancellor of the Exchequer giving retiring pensions to Officers of 15 or 20 years' service I must do the best I can. I think if you go into detail my proposals are not so objectionable as the present system. I do not think it a good thing to introduce a system of exchanges, but I adopt it as the less of two evils. Sir Charles stated very truly that the Army is composed of only two classes, the highest and the lowest. I think that is a very great advantage. Those are two classes of the population that you could not make any other good use of, whereas, if you succeeded in attracting the middle classes into the Army, why you take away men that make excellent engineers, and excellent men of commerce, and you would pay them highly, to do what? to clean belts and do duties that their talents would be thrown away upon; whereas, if you introduce the lowest class, you educate them and give them the opportunity of rising to a higher grade. You make many of them most useful, and many of them excellent members of society. I would say the same thing of the Officers;

the men who go into the Army make excellent Officers, many of them when put into positions of responsibility evince great talent; but if you exclude those men from the Army, or if you make the conditions such that they cannot enter, what will become of them? They will become useless, they will become idle. Under the existing system you utilize two classes that would otherwise be of little value to society. I have the pleasure of agreeing with Sir William Codrington in many things that he has said, especially in his estimate of the different kinds of motives which respectively induce privates, non-Commissioned Officers, and Officers to enter the Army. Allow me to say that in many of the propositions that I have made, I do not propose them as good in themselves, but as the best under the circumstances. You have a great evil, and how are you to get rid of it without money? Of course, if the Chancellor of the Exchequer will give me the money I should consider what to do with it, and I have no doubt it might be possible to devise better arrangements than those which I have proposed, and ventured to hope might be favourably considered, chiefly for this reason, that they could be carried out without adding a shilling to the Army estimates.

Mr. Dyke Acland, M.P.: I rise for the purpose of asking a question. I, as a civilian, came here for the purpose of hearing the opinions of military men on Colonel Robertson's paper. Now, I have had the advantage of hearing from the distinguished General on my left many of the current opinions of the Army. I hope it is no disrespect to him to say, though I feel the importance of them as a matter of military opinion, still they are not new, that they are really an answer to Sir Charles Trevelyan. What I do feel, as a civilian coming here for information, attracted by the programme of Colonel Robertson's paper is, that we have been discussing a speech from Sir Charles Trevelyan and not the paper of Colonel Robertson. I feel it is rather hard on Colonel Robertson, who has given a great deal of thought to a difficult subject, and one which we civilians are anxious to study. We want to know the opinions of military men. We also know that there will be at our backs a very strong public opinion in a different direction from the opinions of the Army. I do not pretend to form an opinion on Colonel Robertson's plan, but it does appear to me to deserve discussion. I, therefore, wish to ask whether a future day can be fixed for an adjourned discussion.

Sir W. Codrington: The paper of Colonel Robertson is an important paper; but I must also say that I feel it a very difficult thing to come down here, and on an incidental discussion—for it was by accident that I came here—discuss papers that are written with great care and ability. The other question, that of purchase, was also brought forward very prominently, partly as an answer to Colonel Robertson's statements. It is one that has been discussed very fully, and with the utmost talent and the utmost perseverance, I mean the question of purchase; that is the only reason that I entered into the question.

Mr. Dyke Acland: I am afraid that I expressed myself in a manner which I should regret, having on private, as well as on public grounds, great respect for the gallant Officer, but what I wished to say was, that I was anxious to hear Colonel Robertson's paper discussed, but, instead of that, it seems to me that we have been discussing the speech of Sir Charles Trevelyan.

The Chairman: Before the meeting adjourns to such day as the Council may think proper, I should wish to make a few observations. Having been brought up in a seniority service, where retirement by purchase has been the rule, I look with great abhorrence upon the system of purchase, and I believe that is generally the view which is entertained now. But the point on which I would venture to make a remark, is in reference to the source from which the soldiers of our Army are drawn. The comparison which has been made between the armies of foreign countries and those of England is, that abroad the conscription is the source from which the Army is recruited; in England it is the voluntary system. I must say that my feelings are strongly in favour of the system which has prevailed in England for so many years, because I believe that as long as Englishmen are what they have been for centuries, loyal, devoted, and brave, they will be able to do what they have always done, *i.e.*, hold their own against all the world. I do not believe there is any army now in existence, which confronted with an equal number of British soldiers, would

to beat them. Therefore, although systems may be introduced, which have advantages over the present system—and Colonel Robertson's, which is the f long years of thought and great study, and has been brought out in such nust necessarily be a useful basis in all future consideration of the subject—still that we may be proud of the Army as it has existed: it is a good Army, I a better Army than exists anywhere else. And if we look forward to have a Army, it will hardly be from getting a better material than that of which it is rmed, but from better organization and arrangements in respect of the pro- of the Officers, rather than from an amalgamation of Officers and men as is suggested. I have no doubt that the paper which has been read, will add the many papers read in this Institution, which have been productive of very esults. I trust that I have the permission of the meeting to offer our best to Colonel Robertson for his valuable paper.

Evening Meeting.

Monday, May 18, 1868.

VICE-ADMIRAL R. SPENCER ROBINSON, Controller of the Navy, in the Chair.

NAMES of MEMBERS who joined the Institution between the 11th and 18th of May, 1868.

ANNUAL.

Dixon, Manley C. M., Lt. 8th or King's Regt., 1*l.* Berkeley, H. F., Cornet 3rd Hussars., 1*l.* Biron, Thos. Viny, Lieut. 4th W. I. Regt., 1*l.*

THE NATIONAL DEFENCES OF GREAT BRITAIN, ESPECIALLY WITH REFERENCE TO THE FUTURE REQUIREMENT OF FLOATING FORTS.

By SAMUEL J. MACKIE, Assoc. Inst. C.E.

IT is impossible to over-estimate the value of a thorough and searching inquiry at this time into the whole question of our national defences, for just as the Navy has been passing through large and important changes, the series of which is not even yet completed, so land and shore defences, in other words, fortifications, are inevitably entering upon a like phase of total re-construction, and enormous waste of money cannot be avoided without free and acute public discussions are facilitated; in short, without a battle of argument and experimental practice. In such a controversy, however, no personal elements ought for one moment to be allowed to predominate, but the main effort should be directed to the attainment of the most accurate knowledge upon which to base the new theoretical projects to be carried into practical operation.

The object of this paper then, is very concise and very distinct. It is considered that the time has arrived when the provision of floating forts for our coast and harbour defences can no longer be disregarded with impunity, and that the safety of the maritime defence absolutely necessitates such auxiliary aid.

The consideration of this subject necessarily involves two separate investigations:—

First. A just estimation of the existing, as also of the prospective condition of our coast fortifications.

Secondly. Admitting the necessity for floating batteries, what is the best form of stable platform for ensuring accuracy of fire from the guns.

The first portion of the subject requires a general review of the condition and progress of our present fortifications, and of the system or systems upon which they are being carried out; and in connection with this an equally general consideration is required of the most important cases of attacks by iron-clad and steam ships, and of the defences made by littoral fortifications since the period of the general introduction of rifled guns and iron armour into the great Navies of our own and foreign powers.

As to the enormous fortifications of our arsenals and dockyards which are proceeding, there can be no doubt that a system which is two hundred years old, cannot be properly suitable for the national requirements at this date. What is called the "modern" system of fortification, is primarily based upon that of Vauban; and even this so-called "modern" system is of far too great age to be appropriate to the necessities induced by rifled and heavy ordnance. One of the main defects of Vauban's system, in all its modifications, and against which those modifications have incessantly struggled, has been that of enfilade, which the power and range of modern artillery has so greatly, almost insuperably increased, whilst the strength of most works has been mainly estimated against attacks by guns of not greater power than our late 68-pounder smooth-bores of cast-iron. The strength required in the parapets for secure protection against modern heavy guns would now involve masses of earth of most inconvenient thickness. The 68-pounder, with 16 lbs. of powder, and the 7-inch breech-loader rifled gun, with 12 lb. charges, will, at a thousand yards range, pierce a parapet of very compact loam of 22 feet in thickness. Our present 9-inch rifled gun has, I believe, completely riddled 44 feet of solid clay. It is evident, therefore, that earthworks of appropriate dimensions against such arms, must involve openings for the defensive fire, such as not only to cause inconvenience and danger in the working of the guns, but also seriously to weaken the line of defence itself.

Another and very great difficulty is incurred in modern fortifications in providing traverses to stop the ricochet of enfilade fire.

Masonry also, we know suffers from modern rifled and heavy guns in similarly increased proportion, and while at 200 yards the old 24-pounder iron shot penetrated into good masonry not more than 20 inches, modern rifled guns will send their cylindrical bolts into solid granite work a distance of more than 14 feet. Even the Armstrong 12-pounder is capable, at 70 yards, of penetrating 33 inches of brick-work laid in cement, and the 80-pounder polygroove rifle, with a 10 lb. charge, sent its shot completely through the wall of the martello tower at Eastbourne, 7 feet 6 inches in thickness, at over 1,000 yards range.

Almost at the dawn of the coming general use of rifled guns, the necessity for which was prominently brought out during the Crimean war, the inadequacy of the existing systems was perceived and commented upon by eminent artillerists and engineers, and most competent men would now be thoroughly agreed, that the modern revolution in arms has entirely changed the data upon which fortifications ought to be designed and erected. That no proper system, adapted to modern requirements, has yet been devised, the state of our published literature will, I think, sufficiently pourtray. Our present forts and fortifications show but too practically the confusion of ideas and ignorance of special requirements which prevail, by their different developments, at different places, upon all sorts of theories, without any reliable bases having been officially laid down. A high authority, the late Professor of Fortifications at Addiscombe, distinctly asserted in 1860, when the development of the manufacture of heavy ordnance had attained to nothing like the rank it now possesses, that there could be little doubt that with rifled guns of such accuracy and range as were then coming rapidly into use, enfilade would be practised with a precision, and from a distance vastly greater than had hitherto been attempted, and it would be a question, he thought, whether any gun on an open rampart would remain undisabled for a day. This being the case, there can be no doubt but that all guns of fortresses must, sooner or later, be placed in casemates, where they are entirely secure.

It is no part, however, of my present project to discuss the difficulties of modern land fortifications, nor to advocate any novel or future system in respect to them. It is quite clear that the range of modern artillery must necessitate the most extensive and formidable works upon the land side of any arsenal or dockyard where the primary object is to protect a large quantity of useful or necessary stores from destruction. Two important systems for such purposes seem to be looming in the future, one in massive lines of lengthy earthworks, defended at intervals by iron casemates or turrets; the other a series of potted guns in holes sunk below the soil, or, far more useful, if an admirable invention be employed, long lines of earthen parapets with railways behind them, from which the heavy guns might be, by mechanical means, raised above the surface, as by Moncrieff's carriages, simply for the act of firing alone, and which, in the latter case, being constantly moved about, could not only follow the motion of troops or ships, but, never remaining in the same place, would keep the enemy in ignorance of their whereabouts. But whatever future system may arise, or whatever combination of existing or coming plans may be hereafter adopted, the future of land fortifications will not be a series of problems how most securely to shut up bodies of men within lines of impenetrable obstacles, but rather the preparation and disposition, in peaceful years, of impregnable fortresses, to form "prepared battle-fields, where the defenders, if inferior in numbers or morale can fight with the greatest advantage under the support of a powerful artillery;" the outworks of the active defence being constructed to allow a whole army, with cavalry and field artillery, to issue forth suddenly from under cover, and to retire with equal facility.

It is in this view of large entrenched camps that the extensive land-works round our naval arsenals, will find their best excuse, whatever opinions may be entertained of the effectiveness or economy of their construction.

It is, however, solely in respect to the shore defences that we have to deal in this paper. The main questions involved are—

First. The direct attack of the port, with a view to its capture.

Secondly. The possibility of a distant bombardment with effect from the sea; and

Thirdly. A sudden raid attempted by ships for a destructive purpose.

The complete capture of an important naval station would necessitate a regular approach, both by sea and land, and could scarcely happen while the British Navy maintained the supremacy upon the sea, or even existed as a powerful force. But such attacks might arise if the English fleet were badly beaten by a foreign foe, or were exceeded in power by the combination of the navies of several foreign States. Sudden naval raids, with a view to perform as much destruction of stores and *matériel* as could within a brief period be effected, are very likely to be frequently attempted in any future wars, and it is mainly against operations which may be accomplished within a period of one or two days that we think it is most important to be guarded; and bearing in mind that bombardments at very long ranges of four or five miles could be performed by the aid of accurate charts, by ships taking proper bearings, with high chances of great destruction in places of large extent, it seems desirable that where enormous shore and strand spaces exist, as at Plymouth and Portsmouth, the factories and stores should be as widely distributed as possible with convenience to the work to be performed. Certain it is, that considering the power of modern armaments, provision for a successful defence must be made during a time of peace, and cannot be effected without enormous outlay of money. Personally, I think that these outlays should be regulated by the condition of the labour market, and that, if executed at a greater rate during periods of commercial distress, they would mitigate the sufferings of the working classes, at the same time that in reducing the poor rates, they would utilize and make properly beneficial the contributions which at such periods are inevitably exacted from the rich and middle classes, either in the shape of voluntary charity or direct taxation.

In estimating the value of our present defences, and in contemplating what ought to be the future direction in which such defences should be mainly developed, it is of the utmost importance to digest the knowledge obtainable from the important operations in the great American war, for the details of those hostilities not only show us the highest development of the old systems of fortifications, in every condition and circumstance of modern needs, but also give us the best information as to the powers of attack by modern rifled and smooth-bore heavy ordnance, as well as of the capabilities of modern iron-clad ships. The main details of the most important cases are exceedingly well given, from official documents, in Lieutenant-Colonel von Scheliha's recent

treatise on "Coast Defence." I think the main results may be very briefly epitomised in these propositions:—

1. That in all cases the American steam-ships, iron-clad as well as unarmoured, were able to pass fixed shore forts, without receiving any seriously damaging injuries. This happened at Mobile, at Forts Jackson and St. Philip.

2. That strand forts, and other low-lying batteries placed near the sea, were always to be silenced by the concentrated fire of the ships. As at Fort Fisher.

3. That where the guns were placed high, say at elevations of from 100 to 300 feet, and separately or in small groups at considerable intervals, the plunging fire was found to be exceedingly distressing to the ships, but which nevertheless were able to pass and repass the forts, subject to considerable danger. The batteries at Vicksburg were of this class.

4. That in all cases,—and this is the most important condition in connection with the present paper,—in all cases *where the ships could be detained by either permanent or floating obstructions under the fire of the shore forts, they were prevented from passing* and attacking more important in-shore stations. This last condition is most prominently illustrated by the affair at Charleston, in 1863.

The position of Fort Sumter, the disposition of the five main forts at Spithead, and the great iron-clad fort behind the Plymouth Breakwater, are practical illustrations of the opinions alike of English and American engineers as to the necessity of having powerful batteries in artificial positions in the sea, the fire from the natural positions on the shore not being equal to control the entire area of the waterway for ships. It is perfectly obvious, then, in considering the future requirements of floating forts as auxiliary to coast defences, that while forts on the shore can only be erected upon the best natural sites, the forts in the sea can be put in the best and most effective places possible. In respect to such artificial sea forts there are, one inherent difficulty, and two inherent objections. The difficulty in mid-sea forts is the obtaining of a proper foundation for the superstructure, and one objection also is of an engineering character, namely, that such forts when successfully erected, may become permanent impediments to free and safe navigation. The other objection is, as in fixed shore forts, that vessels moving at any given speed, can pass out of range of fire in a given period of time; their danger, therefore, of being struck will be in direct proportion to the number of guns employed against them. If the guns be concentrated in one large fort, the chances of the ship being hit will be in proportion to the area of waterway covered by the land fire. If the guns are isolated at distances along the shore, the chances of the vessel being hit will be in proportion to the number of guns, and directly also to the skill of the artillerymen, by whom they are worked. In either case, unless the number of guns be infinite, the period of time required to run the gauntlet of the batteries is definite, and open to previous calculation.

The four great advantages claimable for floating forts are:—

1. That they can take up any position required.

2. That in doing so, they are entirely independent of any engineering requirements or cost of permanent foundations.

3. That they form no permanent obstruction to any commercial or naval waterway, and can, in time of peace, be removed to stations and shelters completely out of interference with any sea-going or harbour approaching tracks.

4. That under the defence of floating batteries there is afforded a direct way of barring the entrance to any port or river, and of arresting the progress of any naval hostile force, at least temporarily, and by proper provision, completely, under the close and searching fire of the floating forts themselves.

5. That by their use, the greatest economy of guns and men can be effected without detriment to the defence.

6. That being free to be moved to any station required, the fire of the floating forts will be available for any required operation so long as the fort and its armament remain not seriously injured.

7. That such floating forts can be made of superior impregnability as well as stability to the most formidable and best designed iron-clad ships.

Upon the first and sixth points no one can dispute the advantages, nor do I think that if a reasonable amount of satisfaction and confidence could be placed in the fort as to its entire impregnability to any anticipated and serious bombardment, and in its capacity for floating even after very considerable damage had been inflicted upon it, that there would be any *à priori* lack of preference for floating over permanent in water fortresses.

Upon the third point it is evident that in many situations a fixed water battery would be of vast value as a measure of defence, if commercial reasons and the necessities of navigation did not forbid its erection. Take, for example, the present undefended state of the Thames, and see of what undeniable and vital importance a mid-channel fort in the river below Tilbury and Gravesend, or between the Corringham and Cliffe Marshes, would be for the protection of London, the enormous number of ships in the pool and surrounding docks, and the almost inestimable stores of goods and merchandize in the miles of concurrent warehouses. A floating fort, even without motive power, so stationed, would be equally as valuable as a fixed one as a means of defence, and could even in time of war, except at the period of actual attack, be moved out of the way of mercantile traffic. In time of peace it might be utilized as a light-ship on the Blygh Sand or at the Nore, or turned to any other useful or economic purpose.

The question of cost of iron-clad floating batteries is one that can hardly be a barrier to their employment when it is proposed to use iron in enormous quantities in the shore defences. Rolled plates of any thickness, light or heavy, will not cost more to manufacture whether placed on the land or floated on the sea, whilst the expense of obtaining floating capacity over a small area on the free water will not in any probability exceed the cost of obtaining extensive areas of valuable land for the shore fort, its approaches, glacis, and necessary surroundings of free and uninterrupted space.

Before approaching the fourth consideration it is requisite to take a brief view of the present and prospective systems of fortifying a large harbour, bay, or inlet, by means of land forts disposed around its shore. The number of guns disposed in the forts at present erected or erecting around Plymouth Sound, is no fewer than 128, namely:—Staddon Point 22, the Breakwater Fort 22, Picklecombe 42, Cawsand 10, Mount Edgecombe 7, West and East Kings 15, Hooe 10, Staddon Heights 34, without reckoning those in Knatterbury and Polhawn, the four Redoubts on Maker Heights, Wilderness Point, Stonehouse Fort, Citadel, Staddon Battery, Brownhill Battery, Staddon Keep, and the two redoubts protecting Milbrook Lake. In addition to these, the waterway is obstructed by the enormous erection of a breakwater of a mile in length, fifty feet broad at its summit, and erected out of deep water varying at neap tides from four to eight fathoms. Behind this rises also out of deep water the masonry foundation of a huge oval iron fort 180 feet on its major axis, now forging at the Millwall Works. This Plymouth breakwater fort is to contain 18 heavy guns. Adverse opinions as to its powers of endurance have been very strongly expressed, but it is neither convenient nor desirable to discuss in this essay its mechanical construction or powers of resistance to the penetration of the guns which may be brought against it. As designed and manufactured it is an open structure, and therefore must be, as a military work, under such circumstances liable to be silenced by a distant shell fire from a sufficiently powerful fleet. If silenced and captured, it could, with any use that could be made of the breakwater itself, be employed as an established point for a new attack upon Drake's Island higher up the Sound, where 35 additional guns are planted, supposing, of course, that the forts at Staddon and Picklecombe had been equally silenced by the enemy's fire. It seems possible thus that a powerful and daring foe might, notwithstanding the present provision of defence, at least perform the like serious sudden and damaging naval operations which were so successfully and continually carried out by those able United States' commanders, Admirals Farragut and Porter. The idea of barring the channels between Picklecombe Point and the west end of the breakwater, and Staddon Point and the east end of the breakwater, by permanent obstructions over the whole, or any considerable portion, of their width, such as was done at Charleston between Fort Sumter and the shore, could never be for a moment entertained in respect to so important a naval station as Plymouth. In war, or in peace, the largest ships of the Navy must at all times have free access to the inner Sound and Hamoaze. The extent of the rise of the tides in the English Channel would also be exceedingly adverse to their employment, as well as to their effectiveness. As Plymouth is at present mainly defended by the three forts in connection with the breakwater, I cannot but think that the fire from them must be too limited to prevent a fleet of any considerable number of vessels from running the gauntlet of those forts with less loss than would materially affect their hostile operations. It would seem, however, that by proper iron protections for the artillery of Picklecombe and Staddon Forts, with auxiliary aid

from two or three floating batteries moored at intervals across the channels, in conjunction with a proper system of heavy chains and floating booms, the Inner Sound might be effectually barred to the most daring naval enemy, and his ships either sunk or put *hors de combat* by a concentrated fire before he could retract his efforts and extract his ships from the dilemma in which they would thus be placed. And here I would make a suggestion whether, by means of some such disposition of heavy chains and booms carried direct across the mouth of the Sound from Penlee to Reny Point, a more effectual defence of the Sound might not have been made than by the 25 land-forts and all their subsidiary erections and their isolated details of heavy guns, every one of which is liable to be silenced in succession by the fire of an adverse fleet. It is inherent in the nature of ships, and floating forts, that fleets of them can be made movable concentrations of force; the defensive system of shore batteries, on the contrary, is distributive invariably under all circumstances. If certainty of obstruction were more esteemed than money expenditure, gigantic floating booms (say 20 feet or more square, and 400 yards in length), in the practical form of iron floating quays, built in water-tight compartments, would present an impenetrable barrier, and would form, in their character of breakwaters, tranquil harbours of the largest extent, and of the utmost value as refuges in stormy weather. Harbours so formed by floating quays would have no tendency to silt up, which is always the case with permanent erections built up from the sea-bottom, and would be the most valuable and economic of any that could be constructed. The very different properties of bitumen and of zinc-sheathing, permit iron to be used in salt water with every advantage. In many cases, therefore, it may be observed that the construction of such works would, in the tranquil times of peace, be profitable and advantageous as commercial undertakings.

Certainly, if any plan of direct barring the water-way be admitted to be advisable, it includes a consideration of the most important character, namely, the capacity of doing more certain destructive work with a few guns than could be accomplished by the land forts with an enormous plant of artillery. Fifty-six guns so disposed at Plymouth would suffice to do much more than the utmost work that, under the most favourable circumstances, could hope to be obtained from the four times that number now placed at intervals around the Sound. Even if such a sea barrier line were broken through, or if even no intermediate obstruction were attempted, a naval enemy could not pass a line of floating forts without the certainty that they would follow him up and attack him in the rear whilst he was operating against the land batteries of the arsenal in his front—a position between two hostile fires which no prudent commander would permit himself to be entrapped into. It is evident that Portsmouth might be efficiently defended by such a cordon of floating batteries, and certainly such structures would be most advantageous auxiliaries to any forts commanding the passage of the Needles. Floating forts taking up positions in deep water channels would drive the enemy's ships towards shoal water, and any accidental grounding would be for them

irretrievable disaster. These sketches are only submitted as suggestions.

This question of the economy of heavy guns has also another and very important phase. More than 2,500 rifled guns of 9 inches bore and upwards, are alone required for the works actually in progress and approaching completion. The national stock is, all told, 265. It takes six months to make one of these heavy guns, and the Royal Arsenal at Woolwich is not equal to turning out more than 40 per annum. It will take, therefore, at this rate, 55 years to man those forts which, according to present rate of progress, we may expect to see in a condition absolutely requiring defence by the end of 1870. Nothing stronger upon the prudence of economy need be said; nor can there be any more forcible proof of the urgent necessity that exists for immediate activity in the production of the first most important instruments of warfare. The greater endurance and comparative cheapness of heavy smooth-bore guns should be regarded in our future manufacture of artillery, and in our present justifiable pride of the magnificent weapons which are now being produced in this country, it should not be forgotten that the ponderous blows of 400, 600, and 1,020-pounder spherical shot will have their special uses, not served by rifle projectiles, and that for straightness and length of range after ricochet, round shot are more to be depended upon than cylindrical bolts. The effort to obtain substantial breech-loading artillery should not be abandoned; the manufacture of wrought-iron mortars should also have attention.

In considering the means of defence for our great naval stations, I desire in no way to overlook or to slight the valuable powers of mortars and torpedoes. Nor do I think that in criticising the designs of the fortification engineerings which for the past eight years have been going on at Portsmouth, Plymouth, Pembroke, Portland, Chatham, Dover, and Cork, this fact should be omitted in any estimate of the propriety of those works at the time they were instituted, that in 1860 when the £11,000,000 was granted by Parliament, at Lord Palmerston's instigation, artillerists and engineers were looking, and the public were doing the same, at the enormous ranges of rifled guns. We have now arrived at quite another aspect, and the question that has come to be mainly regarded is, penetration. It is felt that very long ranges are impracticable for useful or certain results, and that guns may throw projectiles far beyond the visual power of the eye to direct their operation. The most effective defence from the shore will probably be the covering, by previous study and concentrated armaments, of certain areas of the water-way with a shower of missiles; and for this end, bouquets of large mortars, placed in suitable positions to control with a vertical fire the most important navigable channels, and discharged by correspondence signals, like the torpedoes, when the vessels are sighted within the doomed arenas, will be most valuable adjuncts to the careful aim of the rifled ordnance. Heavy guns, placed in isolated iron turrets, defended from *coup de main* by surrounding ditches, would, in many cases, be preferable, I think, to concentrations of ponderous artillery in large open forts. In no case, however, where

the water-way is of any considerable breadth or superficial extent, do I believe it can be effectually controlled by shore batteries obliged to fire at long ranges. Wherever the extent of water area is large, floating forts are, in my estimation, essential requirements, not only as artillery aids to the land forts, but also for the protection of the submerged lines of torpedoes.

Brief as has been unavoidably this summary of the main points of one of the two important subjects included in this paper, the remaining time allotted to me must be devoted to the consideration of the best kind of floating fort; and in doing so, I shall avoid altogether questions of what could be or might be invented, and deal simply with that which I consider is the best plan proposed up to the present time.

Primarily a floating fort ought to be an entirely different structure from a sea-going ship. A ship is built upon lines suited for the attainment of the greatest speed, and adapted to make the vessel rapidly accord with the ever-varying motion of the waves and wind. Liveliness therefore is a first essential in a ship. The first essential in a floating fort, is stability of platform. The conditions of the two are therefore entirely opposed. Speed is not an essential for the fort, but ease and certainty of mooring is a necessary qualification. The properties therefore of ships and floating forts are also different; a ship rolls from one side to the other, and is designed of considerable draught of water, in order that her depth may keep her close in sailing to the wind, and prevent her drifting to leeward; also that her weights being low, she shall maintain a vertical position, her masts and sails springing back to the breeze at every modulation. It is also necessary to her easy passage through the water that she should rise to the waves while cutting through them, and hence the incessant longitudinal, as well as lateral oscillations. The pitch and scend of a vessel brings an enormous nip upon the cables at the hawseholes, and ships, as is well known, are exceedingly liable in stormy weather to part from their anchors. The lateral roll, which is particularly heavy, and must be so in iron-clad ships, renders such vessels all but useless, except in comparatively calm weather, as with a movement of above a few degrees, the port-holes would be liable to plunge under water at the same time that the difficulty of taking accurate aim is rendered very great indeed, if it is not altogether impracticable.

In the first place, however, a distinct objection should be made to the sole employment for harbour defence of old and inefficient ships converted, as it would seem, must necessarily follow, into inefficient floating batteries, because such converted vessels cannot be expected successfully to oppose in vital positions strong and properly constructed ships, for if vessels of the same class be opposed to each other, the strongest and best must have the advantage in the hostilities. It is also I think unwise and injudicious to build ships specially for harbour and shore defence, because ships are not the best form of construction, and ships will always be liable to be taken from their stations, and sent upon foreign expeditions. The floating fort on the contrary as advocated in this paper, is regarded as a constituent item in the defence of the place itself, and not to be with-

is flat and open, as we see it in the model, or whether there is any attempt to deflect the shot from a plunging fire?

Mr. Mackie: I think myself that the flat top is the most effective against plunging fire, on account of the angle at which the shot strikes. But I do not think Captain Moody cares whether the top is made of a dome shape, or flat, or whether it is entirely covered with armour, or whether it is covered with grating. The main point considered by him is the stability of the platform. But with regard to details of that kind, the plan is open to the consideration of practical Officers.

Admiral Collinson, C.B.: How are you going to steer the floating fort?

Mr. Mackie: The proposition is to use hydraulic power, and to have in appropriate positions, large powers of directing the structure astern or ahead, or for the purpose of rotating it. I think there will be no difficulty in applying water power. One great advantage which this fort will have over a ship is, that you will be able to work your engines at lower speed, which will be a considerable speed.

Admiral Collinson: How do you propose to anchor the fort?

Mr. Mackie: It is proposed to anchor it from below. Whether you put anything outside to catch the anchor, or whether you have a space underneath for the anchor to go into, is a point rather for seamen to decide. But I do not think with regard to anchoring, that there will be any difficulty; but whatever difficulty there might be, I think it ought to be got over on account of the value of being able to anchor from below, and of not being obliged to depend upon line and chains. You can always get your anchor fixed with nothing more than a hawse-hole.

Admiral Collinson: I cannot possibly see how you are going to anchor a vessel of that kind.

A Member: The difficulty would be to get the anchor up.

Mr. Mackie: I would prefer that some nautical Officer should help me out of such dilemmas, because naval men have much more practical knowledge on these points than I can have. Captain Moody is present, but I do not know whether he will be disposed to speak, as I am sorry to say that he is suffering from the effects of a railway accident.

Admiral Halsted: Has it been at all contemplated to moor, or anchor the vessel from the centre of gravity entirely, like the proposed mooring of Mr. Herbert's floating fort?

Mr. Mackie: That was a circular fort.

Admiral Halsted: A circular fort, and of a different form from yours.

Mr. Mackie: Of course, if you can moor a circular fort from the centre of gravity, you can moor this in the same way; because if you extend these central lines, the figure becomes that of a circle. But the disadvantage of the circle is that it is more liable to roll than this.

Admiral Halsted: Are you sure of that?

Mr. Mackie: I think so. You will also find this, that a circular fort is more likely to subside into the trough of the sea than this is. I would rather not speak against any other plan; I merely suggest the advantages of this.

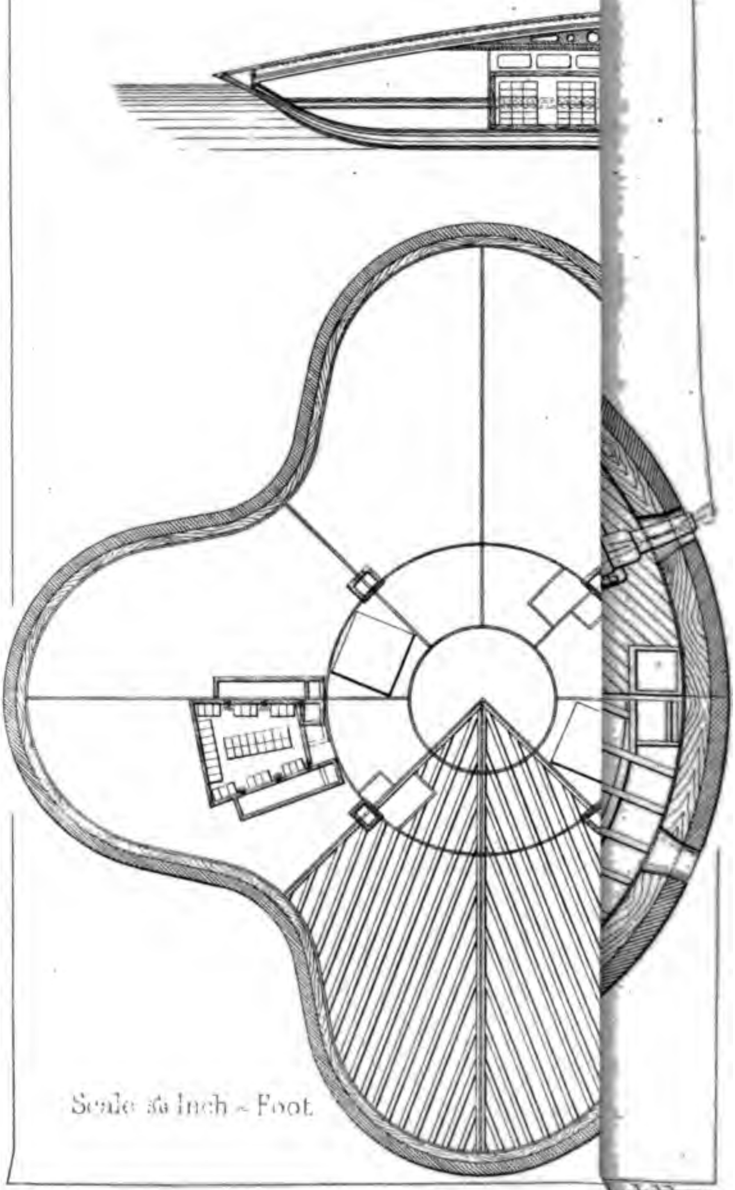
Admiral Halsted: Do you propose that forts on this plan shall be sea-going vessels in any practical sense of the word, so as to be able to pass from point to point along the coast?

Mr. Mackie: Such a fort as this, is distinctly not a sea-going ship; but if you want to make it sea-going, you have only to remove two of the rays, and it will then assume something of the form of an ordinary vessel. This plan can be modified for any purpose.

Mr. J. M. Hyde: It might be interesting to the meeting to know that designs for ships of that description have been for many years submitted to the various authorities of this country. You see the system of ricochet has been adopted in this design (showing a design).

Mr. Mackie: For floating forts?

Mr. Hyde: Yes, these ten years. This is the form of a ship that has been submitted for that particular purpose. You notice the angle, both above and below the water, is 22½ degrees. It will be interesting to the meeting to know that the ricochet, or process of deflecting a shot, has been known for a very long time.



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the accompanying drawings, which require considerable modification, and I may say that I have personally considered many considerable improvements which would render the fort far more formidable than even it appears at present. The naval architect has estimated the speed, with the horse-power referred to, at from 8 to 9 knots an hour. Mr. Ruthven considers 6 knots as more likely; an opinion in which I concur, on account of the great flotation-power which has been given to this design, a power which could be vastly increased at a very insignificant cost, but with a largely increased disproportion of speed. The coal supply is estimated at a consumption of 30 tons per day of 24 hours to suffice for 8 days' full steaming. In respect to speed, however, if such batteries were directed to be built for foreign operations, I feel confident that by an alteration of the lines of the hull, the rate of from 12 to 14 knots might be successfully attained from the modified form. The model of Mr. Moody's lifeboat shows that it is possible to modify his ray-system into effective gun-boats.

Of course to any floating structure the objection may always be raised that it is liable to be sunk. The model exhibited is divided into nine main water-tight segments, namely, a central circular hold, and eight divergent compartments; and it is clear that as many subsidiary bulkheads could be inserted as might be desired. The fort, moreover, if constructed of the strength proposed, is invulnerable to all existing guns, and could be easily rendered, if required, absolutely invulnerable to still heavier ordnance by many auxiliary means well known to seamen and artillerists. The danger, therefore, of the fort being sunk is so remote, that we need not dread that catastrophe. Even under such a contingency, its light draught of water would permit the fort to settle into a fixed position on some shoal, or on the shallow strand, where the deep draught ships could not pursue it. Under such circumstances, in 2½ fathoms water, the fort could continue its fire. I believe I could so construct the central battery that the fire of all the guns, or any required proportions of the armament could be directed from any one side, so as to meet the attack upon any point with the full effect of the defending ordnance.

The power of rotating the fort is valuable too under some conditions in training the guns easily and successively, but the advantage is very great of being able under other circumstances to turn a wounded side away from the enemy in action, and to continue the fight with the guns of the undamaged portion.

Into further minute details either of construction or application of the floating fort, I am not at present disposed to enter, preferring to leave, as much as possible, free scope for modification to the circumstances of every case, and the wants and wishes of the constructive or executive Officers concerned in the direction and command of our national defences, if the Government should think fit to adopt or recognize this, as I consider, valuable invention. I desire only to bring on this occasion the main primary topics under the discussion of this able and practical meeting.

Admiral HALSTED: I should like to ask whether the summit of the floating fort

is flat and open, as we see it in the model, or whether there is any attempt to deflect the shot from a plunging fire?

Mr. MACKIE: I think myself that the flat top is the most effective against plunging fire, on account of the angle at which the shot strikes. But I do not think Captain Moody cares whether the top is made of a dome shape, or flat, or whether it is entirely covered with armour, or whether it is covered with grating. The main point considered by him is the stability of the platform. But with regard to details of that kind, the plan is open to the consideration of practical Officers.

Admiral COLLINSON, C.B.: How are you going to steer the floating fort?

Mr. MACKIE: The proposition is to use hydraulic power, and to have in appropriate positions, large powers of directing the structure astern or ahead, or for the purpose of rotating it. I think there will be no difficulty in applying water power. One great advantage which this fort will have over a ship is, that you will be able to work your engines at lower speed, which will be a considerable speed.

Admiral COLLINSON: How do you propose to anchor the fort?

Mr. MACKIE: It is proposed to anchor it from below. Whether you put anything outside to catch the anchor, or whether you have a space underneath for the anchor to go into, is a point rather for seamen to decide. But I do not think with regard to anchoring, that there will be any difficulty; but whatever difficulty there might be, I think it ought to be got over on account of the value of being able to anchor from below, and of not being obliged to depend upon line and chains. You can always get your anchor fixed with nothing more than a hawse-hole.

Admiral COLLINSON: I cannot possibly see how you are going to anchor a vessel of that kind.

A MEMBER: The difficulty would be to get the anchor up.

Mr. MACKIE: I would prefer that some nautical Officer should help me out of such dilemmas, because naval men have much more practical knowledge on these points than I can have. Captain Moody is present, but I do not know whether he will be disposed to speak, as I am sorry to say that he is suffering from the effects of a railway accident.

Admiral HALSTED: Has it been at all contemplated to moor, or anchor the vessel from the centre of gravity entirely, like the proposed mooring of Mr. Herbert's floating fort?

Mr. MACKIE: That was a circular fort.

Admiral HALSTED: A circular fort, and of a different form from yours.

Mr. MACKIE: Of course, if you can moor a circular fort from the centre of gravity, you can moor this in the same way; because if you extend these central lines, the figure becomes that of a circle. But the disadvantage of the circle is that it is more liable to roll than this.

Admiral HALSTED: Are you sure of that?

Mr. MACKIE: I think so. You will also find this, that a circular fort is more likely to subside into the trough of the sea than this is. I would rather not speak against any other plan; I merely suggest the advantages of this.

Admiral HALSTED: Do you propose that forts on this plan shall be sea-going vessels in any practical sense of the word, so as to be able to pass from point to point along the coast?

Mr. MACKIE: Such a fort as this, is distinctly not a sea-going ship; but if you want to make it sea-going, you have only to remove two of the rays, and it will then assume something of the form of an ordinary vessel. This plan can be modified for any purpose.

Mr. J. M. HYDE: It might be interesting to the meeting to know that designs for ships of that description have been for many years submitted to the various authorities of this country. You see the system of ricochet has been adopted in this design (showing a design).

Mr. MACKIE: For floating forts?

Mr. HYDE: Yes, these ten years. This is the form of a ship that has been submitted for that particular purpose. You notice the angle, both above and below the water, is 22½ degrees. It will be interesting to the meeting to know that the ricochet, or process of deflecting a shot, has been known for a very long time.

Mr. MACKIE: I no not claim that as a principle.

Mr. HYDE: But some gentleman has asked how a vessel of that kind is to be navigated. I say that a design has been submitted for navigating a ship that may be called a fort as well as a ship.

Admiral SIR EDWARD BELCHER, K.C.B.: I see every facility on that floating battery for pursuing the mode of attack which I have generally advocated, and that is the running-down system. That vessel is of 2,000 tons. The "Warrior" is of 9,000 tons. If the "Warrior" rammed at one end, or the segment of the circular form of that, she would cant it in a moment, and it would go down. There is a second difficulty. I do not see how, unless we entirely adopt the hydraulic principle, and it must be adopted also for steerage, how that fort is to be steered about, or how we are to get any velocity out of it to annoy an enemy. Now, the great advantage which I see in that fort, if it is to be made use of at all, is that in the event of an enemy passing up a channel, you may ground it, and make use of it as a grounded battery. In that sense it may be a formidable obstacle in the way; but as far as attacking is concerned, if you have two ships that are determined to take that fort, they have only to pass a chain between the two of them, swing alongside of it, and they will fire down into her decks, and destroy her in two seconds. And with the dimensions which have been given, and with the iron that would be employed to construct that vessel, I maintain that the guns would be very nearly at the water's edge, from the weight of iron alone that would be required to protect it. Or, supposing you took two merchant vessels, and put spars between them, and let them drive with the tide over it, you would completely overwhelm its guns and prevent their being fired at all, while your own vessel passed on and attacked any other forts up the harbour. So far as motion goes, the inventor of the hydraulic system, Mr. Ruthven, has supposed that he would get six knots out of it. Now, I should like Mr. Ruthven to say positively, for he can tell you to the decimal part of a rule, and I see he is sitting there, what is the actual speed that you can possibly get out of that vessel. If that battery has not speed sufficient to run away from a ship that is inclined to run over it, it is absolutely useless.

Captain MOODY: I should like to be allowed to give a little explanation with reference to this battery, in the way of steering or managing it. There will be an outlet of water or sluice, after my principle, by the side of every arm, making eight outlets, so that by working the valves, opening this valve and that valve, you propel the vessel in one direction; if you wish the vessel to go the other way, you open the other two opposite valves, and you propel the vessel in the other direction. So that you can propel the vessel whichever way you like; or if you open one valve, and then another on the opposite arm, you cause the vessel to revolve; or, again, if you wish it to revolve the other way, you have only, as it were, to open the two opposite sluices, and the vessel turns round the other way. Now, in regard to the mooring of the vessel, I should state that the mooring of the vessel comes out at the inward curve there, on two opposite sides of the vessel were a moving crane, or a moving cathead, by which you throw those anchors out, so that they would drop down clear of the vessel, and the chain attached to the anchor would come out below. The vessel, I am confident, would ride with all ease imaginable. As to other vessels coming and covering this battery, so that its guns could not be fired, I cannot conceive how such a thing could possibly take place. You might bring a vessel in the way of those guns, but how to cover and to prevent those guns from being fired into that vessel, I cannot conceive. That is, I do not see it. As for the open space at the top, I think that a grating of sufficient strength would answer two purposes. It would answer for ventilation, and also for protection against shells; that is, it should be made sufficiently strong for that purpose. With reference to the design (Mr. Hyde's) that has just been brought to your notice, I must say that I never heard of that vessel until about half a year ago, and I believe it was patented then; whereas this fort has been patented three years. I cannot say how long that invention has been in operation; but I can say that mine has been patented for three years, while this has been patented for about six months. I only say this for your information. I was not aware that that invention had been brought forward. I do not wish to depreciate any person's plan; I wish that the best plans for the defence of the country may be employed. This

is the battery which I have invented; it has cost me time, trouble, and expense, and if never brought into practice, why there it is. I consider that it will carry the heaviest armour-plating, and be able to defy all modern artillery. Having no greater angle than 22½°, and the arms only about 19°, I believe, according to the general opinion and the practice of modern artillery, that these forts cannot well be penetrated, especially when they have a greater thickness of plating to protect them than ordinary ships: the great floating area of the vessel enables it to carry an immense weight of armour-plating and also of artillery. Remember also that all the guns are brought towards the centre of gravity, so that there is no tendency whatever to cause the vessel to pitch, but rather a tendency to give ballast to that vessel, and to make her more stable than she would be, provided she had no weight there at all. With reference to the rudder there might be, if it was necessary, a temporary rudder, if she was going any distance. But in an engagement, a rudder would be objectionable, or anything else that projected outside the vessel. That is the reason why this hydraulic power is made choice of, because it will do more in a vessel of that shape than it can possibly do in an ordinary vessel. In an ordinary vessel there are two nozzles or places which the water proceeds out of. In this, there are eight places, which can be conveniently worked by valves, so that you have this advantage, that if a vessel was coming direct towards you, and you did not wish to encounter her, you have nothing to do but to open two of the valves and move out of her way; you have the power of moving the vessel any way, or of turning it round upon its centre, or reversing the movement, just as you please, by opening the valves. I make these observations for the information of the meeting, for there are, no doubt, gentlemen present who know more about batteries than I do.

Mr. Hyde: May I be permitted to explain. I may say that ten years ago—

The Chairman: The question certainly is one that has no relation to priority or merit of invention whatever. The question that must occupy the attention of the meeting at this moment is the very remarkable lecture that we have heard on this subject of floating *versus* fixed forts. We are not at this moment discussing any particular form of fort, though I may say the meeting will be delighted to hear the opinions of any gentleman on the subject of the shape or the nature of any floating fort that he may wish to advocate before this meeting. But after all, our great purpose in meeting here to-night is, I think, to discuss with all the light that many people can possibly throw upon it, whether floating forts are essentially necessary for the defence of our coasts and harbours, whether they are preferable to the system of fixed forts, or whether they should be combined with fixed forts. In fact, our attention should be called to the discussion of that important question, how we shall fortify our roadsteads, whether by a combination of fixed and floating forts, or whether by floating forts alone, or whether, as subsidiary to that great argument, any kind of floating fort can be introduced to this meeting which will answer the purpose.

Mr. Hyde: I quite agree with your observations, Sir, but I beg to say that for very many years I have advocated the system of deflection for forts, whether on shore or at sea. We know that modern experiments have shown that no vertical structure that can be erected is able to withstand the direful effects of modern Artillery, and not being able to keep shot or shell out by vertical structure, it does appear extraordinary that a system of deflection has not been recognised in some form. This fort of Captain Moody's gives a remarkable example of the system of deflection. Artillerists say you cannot keep shot out of a vertical structure, and all the recent experiments at Shoeburyness have proved that assertion. If you cannot do that, the next best thing is to construct a fort or ship that will throw them off. Ten years ago the same idea occurred to me as a shipbuilder, and I ventured to submit to the Admiralty, models and designs to illustrate this particular question. I knew, then, that no vertical structure would ever be able to keep out the shot that would be used in the future; and anticipating that fact, I set to work to design a ship that should be able to withstand horizontal fire from any gun that might be made, assuming that deflection must be the process by which the shot or shell should be either thrown under the water, or over the ship. Hence, the lithograph which I have submitted to your notice. The lithograph is not ten years old, but the design is some twelve years old.

Mr. James Chalmers: I am glad to find that Mr. Mackie has rather over-estimated the effects of the railway accident which befell Captain Moody; and also that Captain Moody is so well able to defend his own system, and to give us further explanations respecting it. This is not my speciality, therefore I do not intend to go into the question of floating forts *versus* fortresses, further than one point on which I wish to throw out a remark, for the purpose of giving those concerned an opportunity of explaining a little further. That is, the question of sinkage—the possibility of this battery being sunk. Of course its value depends on its being able to maintain its position under all circumstances. I am not at all afraid of ships like the "Warrior" ever being employed successfully in sinking a battery like that. I think in such a case, the "Warrior" would pretty much resemble the cow that would come in contact with Stephenson's locomotive; it would not be good for the "Warrior." But there is a class of ships that suggests to us that something may come up very soon that would be very damaging and detrimental to a vessel like that. The class of ships I refer to is the "Monitor" class; the "Monitor" class of ships will prove very dangerous to all partially armoured ships. Now, wherever you have mosquitoes you have the mosquito hawk; wherever you are troubled with that pest the ant, you have the ant-eater; and whenever the "Monitors" become the pests of the ocean, you will have a class of ships built expressly for the destruction of "Monitors." They are very low in the water, and the ship to destroy them will be built high in the bow to run right over the "Monitors." The Great Western Railway of Canada had ferry boats made in order to cut their way through the ice. They had a sharp prow made first, and jammed that into the ice, and there it stuck. They then threw that aside, and built another boat with a broad projecting prow; with this, they got on the top of the ice, broke it, crushed it under, and threw it behind them. So a high-built spoon-bowed ship will run right over the "Monitor." I wish Mr. Mackie and Mr. Moody would give their attention to what would be the effect of such a vessel coming between the rays of this fort and running up upon her. That ship could also be built upon the same principle of deflection; and being built specially for running down, would require to carry no guns, no armament. Its mission would be to run up on, over, and crush down a battery of this description. These are suggestions which I throw out, not in any spirit of opposition, because I regard this as one of the most promising floating batteries that I have ever seen, but to give these gentlemen an opportunity of explaining a little further, if they choose, how that battery could be protected against being sunk in the manner I have suggested.

Mr. Zerah Colburn: I feel under some disadvantage in speaking on this paper at all, as I knew nothing of the proposition before I came into this room this evening. But with regard to the possibility of running down such a structure as this, I think every one here will be able to make a simple calculation for himself. I understood Mr. Mackie to say that the diameter of the floating battery is 180 feet.

Mr. Mackie: 180 feet from ray to ray; 114 feet from curve to curve.

Mr. Colburn: Well, supposing it to be circular, I have calculated that it would take a dead weight of 750 tons to put it down one foot in the water.

Mr. Mackie: 55 tons brings it down one inch.

Mr. Colburn: If it were circular it would require, I say, 750 tons of dead weight applied on the top of it to bring it down 1 foot; and of course to bring it down 6 feet, it would require 4,500 tons. A ship like the "Warrior," of 8,000 or 9,000 tons, could not in striking it, lift herself out of the water more than 2,000 or 3,000 tons. That would not put down a battery of that kind any very great depth. However, if the "Warrior" broke a hole through its outer section, so as to let the water in, of course it would go to the bottom. But I think the mere weight of a ship running on to it would not damage it. With regard to the remark of the gentleman about the ferry boat of the Great Western Company of Canada running on the top of the ice, it runs through the ice. I know the boat well.

Captain Hamilton, late C. S. Navy: I merely wish to rise to bear out what Mr. Colburn has said about the difficulty of sinking this battery by a vessel running on the top of her. There was a remarkable action in Albemarle Sound, between a Confederate vessel called the "Albemarle," and four wooden gunboats. The "Albemarle" was iron-clad, and had a knuckle coming out underneath to increase

her flotation. The attempt was made to sink the "Albemarle" in the same way that it is proposed to sink that floating battery. The wooden boat got on the top of her in front, and remained there for 10 minutes; and while in that position, they continued the action and fired into each other. The wooden vessel slipped off, and the iron-clad got away, having had the muzzles knocked off two of her guns. Mr. Mackie will tell us where the water line is here.

Mr. MACKIE: As near as I can tell, the water line is there (pointing out the part).

Captain HAMILTON: In the Confederate vessels the knuckle is below the water line. That knuckle saved the "Tennessee" in the action at Mobile. The wooden vessels there were all provided previous to the attack, with an iron prow. Although some five or six of them in rapid succession rammed the "Tennessee" at full speed, after the action, on the report made by the Officer who surveyed the "Tennessee," there was not the slightest evidence whatever of any harm having been done by the ram. In the case of the "Merrimac" she had no knuckle; and if she had been rammed by the same vessel she would have been sunk in a very few minutes. So I think the knuckle in this floating battery will serve the same purpose as it did in the "Tennessee." It was but for the purpose of giving her the utmost flotation.

A MEMBER: Will Mr. Mackie tell us the height of the port-cills above the water?

Mr. MACKIE: I do not claim anything with regard to these port-cills. These were put in by the artist who made the design, and in their present state they are most objectionable. The plan that I advocate for any such vessel, or for any vessel at all, is that the port-holes shall be contracted as small as possible, be limited as nearly as may be, to the actual muzzle of the gun. There is no doubt that such a port-hole could be made for this vessel, allowing for a considerable range of vertical and horizontal training. I think a port-hole made as near the size of the muzzle of the gun as possible would be sufficient.

A MEMBER: I ask the question more in reference to the question that has been raised, as to a vessel like the "Monitor" getting astride one of the arms.

Mr. MACKIE: That is a question that I must leave till after the discussion, I simply answer the question.

Brigadier-General LEFROY, R.A.: There are two or three questions that suggest themselves to me as a landsman upon which I should like to make a few remarks. It is pre-eminently a nautical question whether such a vessel can be built at all, so as to be strongly framed together and capable of resisting ships running against her; whether she can be built for £84,000; whether she can resist a ram coming against her, of 8,000 tons, at the highest speed. All these are nautical questions that I do not propose to touch. To come back to some of the earlier observations of the lecturer with reference to the shore defences of the country, and to the necessity of supplementing them by floating defences. The lecturer appears to be under the impression that what he referred to as the modern system of fortification, is the system of fortification which is in existence at present. Just as in geology there is a pliocene and a pleistocene period, so in fortification there is a modern and a most modern system. There is not a work constructed in this country since 1860 which has the least resemblance to what is called the modern system of fortification. With regard to the Northern attack on the Confederate Forts, there is no question that the Northern attack predominated. The reason was, that the Confederate forts had very few guns of any size or power. It would be very different in our case. No shot would strike that would not make its mark and have some effect. Then, there are certain conditions to be fulfilled in any structure of the nature of a fort or battery, which has to be occupied for the purpose of defence. It must be habitable, for one thing. You may as well have a barrack composed of sentry boxes, as a battery composed of guns and embrasures. You want a great deal more than that; it has to be occupied by Officers, men, and stores; and under the patriarchial system of the British Government, by women and children. Then, there are certain conditions which are necessary to meet those requisites. I hardly see how they are to be met in this structure before us. It is true there is a considerable amount of space in those curves, but I do not see any provision for giving them light and ventilation. Then,

Mr. Mackie has spoken justly of the great advantage of contracting the aperture to very nearly the muzzle of the gun. But I think he has quite forgotten that the system answers very well in a turret where you lay your gun by rotating the turret. You cannot get any sight through an aperture of that description, where the body of the gun is very much larger than the opening, even if the turret in which it is mounted is itself movable. The contraction to an aperture of that extremely small size is contingent on your being able to lay the gun by extraneous sources, that is by rotating the whole turret. These are the observations which strike me at once. I quite agree with some of the previous speakers that such a structure as this, with six inches of iron on the lower slopes, and nine inches of iron on the upper slopes would be practically invulnerable. I do not think there is likely to be any gun that would breach it. Nor do I think it would be breached by vertical fire, certainly not by cast-iron shells, because they would be broken up by the impact. On the other hand, the opening in the centre is of considerable size; it appears to me to be 40 feet across. Now a circular opening of 40 feet is a very considerable opening, and vessels coming prepared to attack such a vessel would no doubt come prepared to take up the distance at which they knew the exact range of their mortars, and would, I think, before long, throw shells into that opening, and render it uninhabitable. I suppose that there is no one who will deny that there are situations, from the width of channel at different points on the coast to be guarded, where floating structures of some kind or other might be used. That question did not escape the attention of the Defence Committee in 1860. On the contrary they went into it, and considered both floating batteries and ships, properly speaking. Whether rightly or wrongly, they arrived at the conclusion that a ship which is habitable, ventilated on both sides, and capable of locomotion, and containing conditions for men and stores of every sort or kind, would be more suitable for any purpose of defence than a floating battery of any kind. Such was the conclusion then come to. I admit that no ship could have the stability of beam and bow which a structure of this kind would have. The radial form seems to me to be extremely well calculated to give stability, and stability is a matter of great importance. Therefore I am willing to concede that advantage. I think I know of situations in which, if such a thing existed, it might be very useful. But at present it appears before me as a ship with a broadside of three guns, costing £84,000, not habitable, or barely so, because we must remember that all structures that are meant for permanent purposes of defence, at all events for continual defence, can never be left unoccupied; they must in time of war or of alarm be continuously occupied in force. You cannot send the people off when you do not know when your enemy is going to attack you. It appears to me that this hardly meets those conditions, even if it should succeed in the opinion of naval architects in meeting the other conditions of such a structure.

Sir Edward Belcher: The computation of Mr. Colburn is based on the immersion of a cylinder of a certain diameter, provided the weight be placed on the top of it. But if you take a wherry, and put your hand upon the side of the wherry, you can cant that wherry with one hand. Any vessel striking one side of that fort would cant it. I have seen that very model in the water, and tried it myself with the finger, and the slightest touch with your finger will depress it up to the guns. Consequently, I know what the effect of a ship of war running on to it would be; the weight of a ship of war would so cant it, that its guns would be perfectly useless; and they could not possibly fire. But putting that out of consideration, we know how far the vertical sides of a ship can be cut away to enable you to train a gun. But how much will you cut away of that inclined face to train a gun? If you placed your battery at the distance I am now, and anchored a turret ship slightly at one angle, so that both turrets could be brought to bear upon that ship, but two of your guns could possibly fire upon the turret ship, whilst four guns of the turret would look right down upon your deck. I consider the turret-ships we have now would destroy that thing inevitably in half an hour.

Mr. Colburn: Although I was under the disadvantage of not knowing the dimensions of the floating battery when I came in, I know now from what I am told, that it is more like the island of Jersey than like a wherry.

Colonel Jervois, R.E., C.B.: There are one or two observations that I wish to make

to this meeting. I came in rather late, and I was not aware until Admiral Robinson said so, that this proposition for floating batteries was made *versus* forts. In my opinion there is no *versus* in the matter. I have always been an advocate for floating batteries. Ten years ago, I was instrumental in obtaining a Committee, for the purpose of considering the question of floating batteries; and in conjunction with Captain, now Admiral Cooper Key, and Colonel Wilmot, R.A., a proposition was then made as regards what we then considered the best kind of floating battery. The proposal was for a small vessel propelled by steam, with a fixed tower in the centre, guns within that tower, and the vessel to be movable from port to port. That was in the year 1858. It is strange how near that vessel approached to what we now call the "Monitor." No money was voted, however, for floating batteries; and the question slept until I think, about 1862, when the "Monitor" question was raised, after the battle between the "Merrimac" and the "Monitor." It will be in the recollection of those who have paid attention to the reports of the several committees and commissions that have discussed the subject, that floating batteries have always formed part of the proposals for the defence of our naval arsenals and harbours. It is, as I said before, not a question of ships *versus* forts, but of ships *and* forts. The question has also been gone into as to whether it was desirable to have stationary floating forts; and the result of a very close investigation of that matter, which time would not permit me to enter into now, was, that in no case was it desirable to have *stationary* floating forts; that if you have a floating fort, it is better at once to give it the power of motion, and somewhat rapid powers of motion; by so doing, you are able to concentrate a great number of vessels upon one point, and able to make use of them to a much greater extent than you could by having a kind of amphibious creature,—neither a fort nor a ship. There have been other propositions made, somewhat of the sort brought forward so ably this evening, one was by the late Mr. Herbert, of the Trinity Board. It was circular and domed, and pivoted in the centre at the centre of gravity, and it was to be anchored there. It was in certain respects different from the proposition which is now before us; but it was, nevertheless, as far as it went, an effective floating battery. My own opinion, whatever it may be worth as regards the subject of floating batteries, is, that the proper kind of floating battery is a "Monitor" vessel, with either one or two turrets, as the case may be; but that in addition to this, and probably to a greater extent than you would apply the "Monitors," you should have small vessels carrying one gun a piece. I saw in one of the scientific papers the other day the drawing of a vessel that appeared to me to answer that purpose admirably, a vessel called the "Staunch," designed by Mr. Rendel. That kind of vessel would only take ten or twelve men to work its gun. It costs only about £7,000. Supposing the battery brought forward this evening to cost £84,000, you would get twelve vessels of that kind for one of these. And those vessels could move about in shoal water, or in deep water. Supposing a hole was knocked in one of them, and supposing she went down, the men could get into a boat and row away; and you could get the vessel up again afterwards, if you liked. Her invulnerability is due to her small size. I would say that I desire to see floating batteries applied in conjunction with forts for the defence of our harbours; they are part of a system which has from the commencement been advocated.

Mr. William Smith: I think the design of Mr. Herbert was originally intended, if not exclusively, in the first instance, for floating buoys. It was circular in shape. Afterwards there was a proposition to fit it with guns, but I never heard that it was intended to move it from place to place, or that it was to have means of self-propulsion. I saw the first designs that were made, and those were deposited in the Admiralty. I believe the reference made by Mr. Moody this night to the design which was brought out by Mr. Hyde was made under a misapprehension. If I remember rightly, Mr. Hyde projected his plan some ten years ago. The vessel was not circular; it was not like this battery in any shape or way, but was really a steam vessel having a turtle back; that was the main feature of it. I think, although it is not usual to refer to any rival designs, and it is always well to avoid that certainly, that Mr. Moody has made some mistake in supposing this design of Mr. Hyde's has only been produced within the last six months; he has probably confused it with

something that no doubt is very vividly in his mind at the present moment. I had my attention called to-day, in expectation of hearing the paper of Mr. Mackie, to this specification of Mr. Moody's patent. I must say that I am very much surprised to hear Mr. Mackie describe a series of ingenious contrivances as embodied in the design of Mr. Moody which do not exist at all in the specification of Mr. Moody's patent. Of course a man can only be bound by that which he specifies, and all that has been ingeniously described by Mr. Mackie may have been or may not have been in the mind of Mr. Moody at the time he conceived this ship. It is little more than two ships of broad beam being placed across one another; but as to the idea of propelling the battery by hydraulic jets, I must say that I am rather surprised to hear Mr. Mackie say it is part of Mr. Moody's original design. I do not think it is material; it is very ingenious, but I think the ingenuity is more due to Mr. Mackie than to Mr. Moody, judging from the blue book which has been placed in my hand to-day. It is a very useful form of moored floating battery. I think Admiral Belcher is right in saying what he did as to the small amount of weight necessary to cause that vessel to cant and slide under the "Warrior," or any other vessel that may override her. I think it is quite a different case from a circular ship where there is a much more uniform and larger bearing. I think any vessel of the "Warrior" class running across one of those projections would certainly sink the ship. When that model was exhibited the other night at the Royal Society, where it was floating, you might have found that it was easily depressed by placing your finger on the end of that projection, so as to cause the battery to sink.

Mr. Zerah Colburn: I trust I may be allowed to make one other observation. I supposed the ship at first was a circular vessel, as I said, but with regard to tipping the ship over, of course the weight must either be applied directly on the top of it, or must be applied at one edge of it. We will draw a diameter across a circular ship, or take the longitudinal axis of a ship of any length whatever; to depress it on one side you have got to lift the same amount of weight out of the water on the other. It does not make any difference, you cannot upset it unless it has got a very low free board. Of course, if a vessel has only six inches or a foot, and you get it under water the water gets into it and it sinks, but not by running down. I think it ought to be said in justice to the late Mr. George Rennie, that he laid before the British Association in 1858 a plan for a floating battery. I do not know that it was identical with this, it was a circular floating battery. I cannot recollect whether he proposed to give it any means of propulsion, or whether he meant merely to moor it. It had angular sides and was heavily armoured. That was in 1858.

Sir E. Belcher: One fact is worth a thousand assertions, I have with a vessel of 340 tons so depressed a portion of a field of ice, seven feet in thickness, as to cause it to disappear under her bows.

Mr. Colburn: The ice was not of the same specific gravity as the ship you were sailing in, that is an important difference.

Admiral Halsted: I can venture to say that my friend, Mr. Herbert's proposal for a floating battery was from the first that it should have its own means of propulsion, not at any very great rate of speed, but so that it could be taken in or out of harbour, or from post to post. Its essential mode of action was a means of rotation.

Admiral Robert Gordon: I came here to-night without the slightest intention of taking any part in the discussion, hardly knowing, indeed, what the subject was, but some reference has been made to Mr. Herbert's principle of mooring, and to that only I wish to address myself. I may take upon myself to say that he *practically* knew very little about that. I can give Mr. Herbert the greatest credit for the ingenuity of the idea, of mooring from the centre of gravity. As far as small buoys were concerned, it answered perfectly, and the principle has been continued to the present time; but with large bodies it proved a total failure, they were perfectly unmanageable, and could not be retained in position with the strongest moorings, they broke adrift, they cost enormous expense, and were worse than useless. I do not wish to detract from the merits of a person now dead, but I happened to know from the commencement, something about these buoys; the principle was good, but on a large scale it failed entirely; it has therefore occurred to me, how could such a large body as that battery be moored?

Admiral HALSTED: I may say that I have taken as much interest in my late friend, Mr. Herbert's invention, as my friend here has. It was never tried but in two cases on the larger scale, and which failed under circumstances bearing no relation to the cause which has been suggested.

The CHAIRMAN: I think the time has arrived for the lecturer to answer the objections that have been made to his plan, and to combine in that answer any observations that may have occurred to him from the remarks that have been made by the various gentlemen who have taken part in the discussion.

Mr. MACKIE: It remains for me to say very little on the present occasion. I have to thank this audience for the courteous, able, and scientific manner in which they have discussed my paper. I would only say for myself that I simply placed it before them on account of the value that I thought attached to the stability of that fort. General Lefroy, I think, slightly misunderstood me, or rather perhaps I expressed myself somewhat too strongly with regard to limiting the port-holes to the exact size of the muzzles of the guns. What I meant to convey was, that I thought the object to be attained was to restrict the size of the port-holes to the narrowest possible limits. With regard to Admiral Belcher's view of running down this battery, I think I heard a remark from Mr. Colburn to the effect that this battery was more likely to run down the "Warrior" than the "Warrior" was to run down the battery. If he did not say so, I thought so myself. Mr. Colburn was perfectly correct that you cannot press one end down without lifting the other end out of the water. The flotation of one end is supported, but the weight to be lifted at the other end is a dead weight. I do not know what the weight is, but I know it must be considerable. I do not think with such a knuckle over as this battery has got, that any ordinary vessel could get on the top of it. This edge is well guarded, the armour plate is carried down underneath to the water line below it, therefore, I think, any ship, unless a very strong one, running upon this would certainly get some amount of injury. But I will go further than that, and I will suppose that Admiral Belcher has got his ship upon the top of one arm; I contend, then, that the form of that arm is such that it will draw out from under his ship. It is a curved wedge, and with the flotation of the water beneath, I maintain that this battery will pull herself out from underneath. With regard to Colonel Jervois's remarks upon fixed forts and fortifications, I purposely avoided any reference to the construction of forts; I am not very well aware of the discussion that has been going on on that subject. My object in bringing this matter before this audience is, that as a writer for a large and powerful journal, and associated with many gentlemen of ability who are capable of forming opinions, I desire sincerely to be informed upon certain points correctly and truthfully; beyond that, I have neither interest nor motive in bringing this subject before the meeting.

The CHAIRMAN: I think we are all extremely indebted to Mr. Mackie for the intelligent way in which he has brought this subject before us. In importance it is second to none. The defence of our shores and the defence of our arsenals is, no doubt, a subject which occupies everybody's mind with a very great degree of anxiety to combine those requisites for a proper defence. The general principles that Mr. Mackie started with at the commencement of his lecture must be admitted, I think, by everybody—the combination of floating defences with fixed defences on shore. I am afraid the discussion this night has not advanced much beyond the bare fact that I have stated; everybody wishes to see a combination of shore defences with floating defences, but, as is usual in all these matters, there is a great variety of opinion indeed as to how that combination shall be effected. Mr. Mackie has brought before us a very ingenious specimen of a floating defence, and I think the remarks that have been made upon it will probably enable himself and Captain Moody, perhaps, to modify or to improve this design, or set them thinking on some other design which shall be acceptable, and prove to be the best form of floating defence that can be used in combination with land defence. No doubt the attention of people cannot be too much called to these important subjects. Everybody here, I am sure, will agree in the vote of thanks that I propose to Mr. Mackie for the able lecture that he has given us.

Evening Meeting.

Monday, June 1st, 1868.

Admiral Sir Henry J. CODRINGTON, K.C.B., in the Chair.

NAMES of MEMBERS who joined the Institution between the 25th of May and 1st June, 1868.

ANNUAL.

Ward, Hon. W. J., Capt. R.N.
Playfair, W. M., Lieut. 107th Regt. 1*l*.

THE AMERICAN NAVY; ITS ORGANIZATION, SHIPS, ARMAMENT, AND RECENT EXPERIENCES.

By John Randolph Hamilton, Esq. (late C. S. Navy).

Mr. Chairman and Gentlemen,

At the request of your Council I have the honour to read you, this evening, a paper on the American Navy; its Organization, Ships, Armament, and Recent Experiences.

Although I do not assume in any way to be the representative of that Navy, I have, however, availed myself, in the preparation of this paper, of the recollections which remain of the fifteen years I passed in that service, and which have aided me, I trust, in avoiding a partial and prejudiced selection of the facts to be placed before you—facts derived for the most part from official reports published by the Navy Department at Washington, from such reports as I have been able to obtain from Confederate sources, and from private letters from, and notes of conversations with, competent and reliable authorities.

It is not my purpose to dwell on the earlier history of the United States' Navy, but after a few remarks upon its present organization, to pass to the consideration of those more recent experiences which will, I hope, enable you to form an opinion upon the merits and demerits of its ships and their armament.

Although the President of the United States is by law Commander-in-Chief of the Navy, the actual government of that department

is vested in the Secretary of the Navy, who is appointed by the President, with and by the consent of the Senate.

To aid the Secretary in the discharge of his duties he is assisted by the heads of the several Bureaux, which are appointed by him by selection from the different grades and corps of the service, respectively in relation to the duties to be performed. Hence the Chief Constructor of the Navy is the head of the Bureau of Construction, the Engineer-in-Chief that of Steam Engineering, and so on.

These several Bureaux form the Navy Department, and are most of them under the same roof with the Secretary of the Navy, who is the centre of information and authority, and who has, of course, a civil staff attached to his own office to assist him in the discharge of his immediate duties.

The authorized grades and corps of the Navy are not sufficiently different from those of your own Service, to render it important to enter into details of their organization.

Promotion is by seniority, and by selection for distinguished services during war.

There are on the active list of the line 592 officers of all grades from Admirals to Midshipmen inclusive.

No person can be appointed a Midshipman who has not graduated at the Naval Academy, to enter which he must be over 14 and under 18 years of age at the time of examination for admission, must be physically qualified to discharge the arduous duties of an Officer of the Navy, and must possess at least an elementary English education.

The course of instruction which reaches the higher branches of mathematics, astronomy, navigation, seamanship, gunnery, steam, naval architecture, and modern languages, extends over a period of four years, and the graduates pass to the active list in the order of their merit. There are at present on probation at Annapolis 344 Midshipmen-cadets, divided into four classes, and instructed, except in one or two departments, exclusively by officers of the line of the Navy, who are graduates of the Institution, and who are generally assigned by selection to this special duty for a term of three years. There are attached to the Academy two or more training ships, in which three of the classes cruize each summer to be instructed in practical seamanship, gunnery, and navigation.

Admiral Porter in his last report as Superintendent of the Academy, in speaking of the Department of Naval Architecture, says, "This will "finally come to be one of the most important studies at the Academy, "as well as the most attractive, and I hope the time is not distant when "the Navy will furnish its own constructors from Officers educated at "the Naval Academy."

So far it has fully answered the purposes for which it was created. From its organization in 1845, under Commander Buchanan, to the present time, with Admiral Porter as its Superintendent, it has enjoyed the confidence and support of the country and the gratitude of every man whose privilege it has been to participate in its advantages.

On March 4th, 1861, the Steam Navy of the United States consisted of the followihg vessels:—

No.	Rate.	Paddle or Screw.	Guns.
7	Frigates	Screw..	262
6	1st Class Sloops ..	"	109
8	2nd " ..	"	41
5	3rd " ..	"	28
4	1st " ..	Paddle	46
4	2nd " ..	"	8
34	wooden vessels	of all classes and	494 guns.

At the commencement of the late American war, the problem which presented itself to the Government at Washington was, to blockade the seaports of the Confederate States, and to occupy them whenever their defences could be reduced; to gain control of the western rivers, and to cut the South in two from east to west.

To meet the Federal fleet the South was utterly unprepared. Of the means of creating even an efficient fleet of wooden vessels it was perfectly destitute, except in the trees standing in its forests, and the coal and iron which were hidden and undeveloped in its soil. There were no large ship-building yards, few factories of machinery, and but a limited amount of skilled labour. When I tell you that the bolts and fastenings of the armoured floating batteries built subsequently at Charleston were in part made of the lightning conductors taken from the ruined portions of that city, you will understand the extremities to which the Southern ship-builders were sometimes reduced.

In the summer and autumn of 1861 a fleet of partially armoured steamers had been built in the West, and early the next year opened up to the Federal transports the waters of the Tennessee and Cumberland rivers, covering the flanks of the advancing Federal Armies, and endangering the Confederate communications, and compelling the abandonment of Tennessee by the latter, and the loss of its supplies of food, iron, and coal.

Iron-clads.

The first naval operations of the war on the seaboard, were conducted in wooden vessels, but in August, 1861, Mr. Welles, the Secretary of the Navy, issued tenders for plans and estimates of armoured vessels, and in a few days afterwards a board of officers was convened to take into consideration the designs submitted to them. On the 16th of August they reported of Mr. Ericsson's model:—

"This plan of a floating battery is novel, but seems to be based upon "a plan which will render the battery shot and shell proof. We are "somewhat apprehensive that her properties at sea are not such as a "sea-going vessel should possess, but she may move from one place to "another on the coast in smooth water. We recommend that an "experiment be made with one battery of this description on the terms "proposed, with a guarantee, and forfeiture in any of the properties "and points of the vessel proposed. . . . . . . Price 275,000 "dollars (£55,000). Time 100 days."

It is so much the habit of the day for the outside world to find fault with and criticise the conclusions of professional committees, that I can refrain from asking you to bear in mind this report, and you will see the soundness of the opinions it expressed, were justified by subsequent events.

As completed, the following appear to be the leading dimensions of this floating battery, which was named the "Monitor:"—

Extreme length on deck over the armour	173 feet
Extreme beam on deck over the armour	44 feet
Depth	12 feet
Displacement	1,255 tons
Length of iron hull	127 feet
Width	36 feet 2 in.
Draught	10 feet
Projection of armour shelf forward	14 feet
Projection of armour shelf aft	32 feet
Thickness of side armour above water	5 inches
Thickness of side armour below water	4 to 3 inches
Thickness of backing	27 inches
Inside diameter of turret	20 feet
Height of turret	9 feet
Armour of turret in inch plates	8 inches

Armament two 11-inch 7½-ton Dahlgren guns.

The turret revolves upon a spindle, and not upon its base, as in Captain Coles's plan. The pilot-house was forward, and not on the top of the turret, as in the later monitors.

At the same time the Board advised the building of the "New Ironsides," a frigate of the following dimensions:—

Length	220 feet
Beam	60 feet
Depth	23 feet
Displacement	3,296 tons
Speed (estimated)	9½ knots
Armour	4½ inches
Horse-power, nominal	1,000

Armament—14 xi-inch Dahlgren's and two 150-pr. Parrot rifled guns.

The "New Ironsides" was built of wood and iron combined. She was a casemated vessel, with unarmoured extremities, and employed during most of the war in the operations against Charleston. It would seem, however, that the Navy Department at Washington, deemed the monitor system the best for the purposes of the war in which it was then engaged.

If we look at the "Monitors" employed in the war, as floating batteries, capable of making voyages along the coast, we shall be able to do far more justice to the excellence of the conception, than if we try to exaggerate them into ocean cruizers. Mr. Welles distinctly states

in his annual Report for 1864 :—"Only two of the 'Monitor' class of "vessels, the 'Dictator' and the 'Puritan,' are proposed for sea "service. Their success, of which the builder and inventor is san-"guine, is among the experiments that the period and the exigencies "of the country have imposed upon the department."

The conclusions to be deduced from the remarkable voyages of the "Miantonomoh" and "Monadnock," are not sufficient, I think, to promote even these two excellent monitors to the dignity of cruizing vessels; that is to say, vessels capable of keeping the ocean under all circumstances, in all latitudes, and in all weather, for six months.

Granting, however, that monitors of the "Miantonomoh" class are capable of carrying, under convoy, their 15-inch guns into any sea, and that they are an improvement on the earlier monitors, let us endeavour to ascertain from the experiences of actual war the value of the latter for the purposes of offence and defence.

The first action of the late American war between armoured vessels was that of the "Monitor" and the "Merrimack," in Hampton Roads, on the 9th March, 1862.

Action between "Monitor" and "Merrimack."

When the Federals abandoned Norfolk, in Virginia, during April, 1861, they partially destroyed the "Merrimack," a 42-gun frigate of 3,200 tons. The Confederate naval authorities, finding that she was uninjured from the water-line to the keel, decided to convert her into a casemated armoured floating battery, and to make her as strong as the limited means at their disposal permitted. The central part of the ship was covered with a roof of stout timber of oak and pine, 30 inches thick, and pitched at an angle of about 30°. The plating was 4 inches, in plates of 2 inches each. On the 8th of March she destroyed the "Cumberland" and "Congress," and on the 9th, fought the "Monitor" and "Minnesota" for four hours.

I do not find in the Federal despatches any details setting forth exactly the extent of the injury sustained by the "Monitor," but as it is stated she was ready for service the next morning, we may presume it was not serious. There is a letter from Chief Engineer Stimers to Mr. Ericsson, which is published by the Navy Department, and which throws a little light on the subject :—

"I consider," says Mr. Stimers, "that both ships were well fought. "we were struck twenty times, pilot-house twice, turret nine times, "side armour eight times, deck three times. The only vulnerable part "was the pilot-house, one of your great logs, 9 by 12 inches, is broken "in two. The shot struck just outside of where the Captain had his "eye, and it has disabled him, destroying his left eye, and temporarily "blinding the other. The turret is a splendid structure. : . . . . "You are correct in your estimate of the effect of shot upon the men "on the inside of the turret when it was struck near them. Three "were knocked down, of whom I was one; two had to be carried "below, but I was not disabled at all, and the others recovered before "the battle was over."

I am glad to have it in my power to give you authentic information as to the condition of the "Merrimack," after her two days' fighting. Admiral Buchanan, who commanded her in the first day's encounter with the wooden fleet, was so severely wounded on that occasion, as to be compelled to turn over the command of the ship to his executive Officer, Captain Catesby Jones, and who commanded her in the action with the "Monitor."

When your Council did me the honour to ask me to prepare them this paper, I wrote to Captain Jones for information on the subject of the performance and condition of the "Merrimack," during and after her actions in Hampton Roads, and he wrote to me, to this effect, in October last:—

"The 'Merrimack's' efficiency and strength were very much ex-" aggerated, by both the South and the North; she was one of our " weakest iron-clads. In the 'Atlanta' the roof extended beyond the " side some feet, forming a knuckle, which added very much to the " strength and efficiency of the vessel. The 'Tennessee,' also, had " this knuckle, and it enabled her to stand, without injury, being run " into repeatedly by heavy vessels in the Mobile fight. Now, the " 'Merrimack' had no knuckle. The roof commenced at the side, it " did not project at all beyond. The screw was exposed; in fact, it " had no protection whatever, any small tug could have disabled us. " The prow was of cast-iron, and not properly secured to the stem, " consequently, we saw no more of it after running into the 'Cum-" berland,' and when we ran into the 'Monitor,' struck her with the " broad jagged wooden stem. A good prow might have done mischief, " although the speed on striking was not great.

"Our battery consisted of four single-banded rifled guns, two " 8-inch, and two 6·4-inch, and six 9-inch Dahlgren smooth-bores. " *We had no solid shot on board, except a few 9-inch of reduced diameter,* " *to be used as hot shot,* consequently were unprepared to fight an iron-" clad, although we did fight the 'Monitor,' until she ran into shoal " water, where we could not follow. See the Federal Report of Cap-" tain Van-Brunt, who commanded the 'Minnesota.'

"My opinion was asked before Commodore Tatnall's Court of In-" quiry, as to the relative strength of the two vessels, and I replied, " that the 'Monitor' ought to have sunk the 'Merrimack' in fifteen " minutes. I really thought she might have done it in five. Her pro-" jectiles of 11-*inch* broke our armour, and caused the wood backing to " bulge in-board, *but none of the projectiles went through.* Our great " draught of water, 22 feet, interfered very much with our movements, " and ultimately caused her destruction. We got aground once during " the fight with the 'Monitor,' in spite of all of our care, and could " only pass the bar once in 24 hours, or we would not have gone up " when we did.

"When we came out of the action, a portion of the roof was only " awash. We had but one inch of iron below the roof—a single shot " there would have sunk us."

The passage which corroborates Captain Jones's statement as to the "Monitor" retiring first from the action, will be found in an extremely

well-written despatch, addressed to the Secretary of the Navy at Washington, by Captain Van Brunt, and dated on board of his ship, the "Minnesota," the day after the action.

The "Monitor" you will remember was lost south of Cape Hatteras in the following December, and with her perished four officers, and twelve of her crew. The rest on board were saved by the quarter-boats of the "Rhode Island," the steamer that was towing her towards Charleston. Of the cause of this disaster to the "Monitor," her Commander says in his official Report:—

"I am firmly of the opinion that the 'Monitor' must have sprung "a leak somewhere in the forward part, where the hull joins on to the "armour, and that it was caused by the heavy shocks received, as "she came down upon the sea."

However unfit this little vessel was to face the wintry weather of the North Atlantic, yet she rendered valuable services to the Federal cause, and by her presence at Hampton Roads, retained the control of the waters of that bay, which was at one time apparently lost to the Federals, and indirectly caused the destruction of the "Merrimack," when Norfolk was evacuated by the Confederates, because her great draught prevented her being carried into James River. To have lightened her up sufficiently to pass the bars of the river, would have exposed the unarmoured portions of the hull below the usual load line, and have given the "Monitor" and her wooden consorts the opportunity for which they had so patiently awaited, either to capture or sink her.

Monitors of the Passaic Class.

The Government at Washington, and the Congress of the United States, greatly elated at the performances of the "Monitor," immediately after her action with the "Merrimack," ordered the construction of nine other vessels on the same system, but somewhat larger, and of what is known as the "Passaic" class.

Leading Dimensions of Monitors of the Passaic Class.

Length on deck	200 feet
Width on deck	45 feet
Depth on deck	12 feet
Length of hull proper	159 feet
Width of hull proper	37 feet 8 inches
Overhang of armour shelf forward	16 feet
Overhang of armour shelf aft	25 feet
Tonnage	844 feet
Draught of water	10 feet
Thickness of side armour in inch plates	5 inches
Thickness of side backing	39 inches
Thickness of deck plates	1 inch
Thickness of turret in inch plates	11 inches
Inside diameter of turret	20 feet
Height	9 feet

Armament, two 15-inch 20-ton smooth bores, or one 15-inch, and one 11-inch, smooth-bores, or one 15-inch, smooth-bore, and one 150-pr. Parrot rifled gun.

New Orleans.

Pending the construction of these vessels, which were intended primarily for operations against Charleston, and after its reduction, that of Savannah and Mobile, Admiral Farragut made his passage of the New Orleans forts, with his wooden fleet, and destroyed the Confederate flotilla that opposed his progress up the river to the city (Plate xii, fig. 3).

These forts which stand on the banks of the Mississippi, diagonally opposite each other, and about a mile and a quarter apart, are casemated brick structures built before the war, and deemed by the United States' Engineers an ample defence for the City of New Orleans, and the entrance of the Mississippi River. In this belief, the good people of New Orleans, and the Confederate General commanding the department seemed also to have indulged, until the genius of Admiral Porter, giving direction to the dash of Admiral Farragut, disturbed the dream of security, when it was too late to ward off the fatal blow, which gave the Confederacy its first mortal wound.

Federal Fleet.

Admiral Farragut's fleet consisted of about thirty steamers, the "Hartford" with a battery of heavy 9-inch guns, being the flag-ship. There was a flotilla of nineteen mortar-vessels, each carrying a 13-inch mortar, under the immediate command of Admiral Porter, to whom was due the conception of reducing the forts by a bombardment from heavy mortars, and when the offensive powers of the fortifications were greatly weakened, to cut the communication with New Orleans, by forcing the passage at night with the steamers, under the cover of a heavy fire from the mortar-flotilla, and its supporting gun-boats. This was accomplished after six days' bombardment, on the first of which 1,400 shells were thrown, from distances of from 2,850 to 3,680 yards. The mortar vessels were hidden from the forts by the forests on the river banks.

Admiral Porter in a paper on Coast Defences, which has been published by the United States' Navy Department, refers to this bombardment, and its effect in facilitating the passage of the vessels under Admiral Farragut:—

"I recommended," says he, "in the early part of the Rebellion an "attack on the forts at the entrance of New Orleans, Forts Jackson "and St. Philip. I consulted with General Barnard, who furnished me "with correct maps and plans, and agreed with me in opinion that the "forts could be taken by ships and bomb-vessels. All the guns of "these forts that were of any use were *en barbette*. The few that were "casemated, were nearly level with the water, the fort having settled. "The history of that event is well known. The mortar-vessels had "disabled Fort Jackson, so that no ships were struck on that side, "and the men from the exposed guns of Fort St. Philip were driven

"to shelter after a few broadsides from the vessels as they passed.
"The best resistance opposed by the enemy was from some rams
"and gunboats, but they were soon demolished, and the ships
"passed up . . . . . Here were two forts mounting near 100
"guns, that were passed by a squadron of wooden ships with shell
"guns, when the enemy had strong currents on their side, and bad
"shoals to interfere with the progress of our vessels. It was perhaps
"one of the most difficult positions for ships at night amid smoke,
"flames, and rams, and in my opinion, settled the problem about
"steamships passing forts when there was plenty of water. In this
"instance only a fleet of well-constructed monitors or powerful rams
"could have stopped the advance of our fleet."

Every effort had been made to get ready to participate in the defence of New Orleans, a powerful armoured-floating battery the "Louisiana." The Federals through their spies were well informed of the actual condition of this vessel, and her consort the "Mississippi," and consequently urged forward the preparations for the attack, which took place before the "Louisiana's" machinery was completed, and before "the Mississippi" had received her plating. Both vessels were set on fire to prevent their falling into the hands of an enemy, that either of them could have destroyed a few weeks later.

Naval Mortars.

The diagrams Nos. 1 and 2 (see Plate xi, fig. 1) show the method of mounting mortars on board mortar-vessels in the American Navy.

The carriage and slide are of wrought-iron, the latter secured to the circle or turn-table (1). The carriage is mounted upon excentric wheels (8), which are thrown in or out of gear by placing the levers in the excentric sockets (7). Before firing, the wheels are put out of gear, and the carriage rests upon the slide upon which it recoils; when the piece is to be run into battery after loading, the wheels are thrown in gear, by again placing the levers in the excentric sockets, and heaving upon them. By an arrangement of the excentric axle, the wheels remain in gear when the levers are withdrawn, and placed in the holes in the rims of the wheels, and by heaving forward, the mortar is run out. The turn-table is also mounted on excentric wheels, which must be thrown in gear, and kept so by pinning down the circle excentric-levers, while the piece is being trained. The piece shown in the diagrams is a sea-coast, 13-inch mortar, weighing 8 tons.

Working of Monitor Guns.

Before passing to the consideration of the operations against Charleston by the iron-clads under Admirals Dupont and Dahlgren, I will, in as few words as possible, explain the manner of working the guns and turrets as shown in diagram No. 3 (Fig. 2).

The rammer and sponge are in sections, which are screwed together as the sponge and the rammer are passed down the bore, and are unscrewed as they are withdrawn. This is a consequence of the limited

space for loading in the turret. The powder is received through th ammunition scuttle, *a*, as is also the shell or shot, which is whipped to the travelling bar, *d*, on which the shell whip moves, and which b is brought over so as to permit the projectile being placed in the muzz when it is rammed home with the rammer in sections, as already de scribed. To run out the gun, the compressor, *f*, is eased, the truck crank, *g*, is manned, and as the muzzle approaches the port-stopper, the port is opened. The gun being out, the compressor is hove taut first by hand, and then by the ratchet levers. To train, the officer a the sight holes, *s*, orders right or left, as the muzzle is to go, and *th* Engineer at the starting-bar, *b*, revolves the turret, the Officer gives the order to fire, and the Captain of the gun pulls the lanyard. The port tackle is let go, and the port stopper closes the port. The Enginee revolves the turret so as to point the gun abeam, which gets the scuttle clear for passing ammunition.

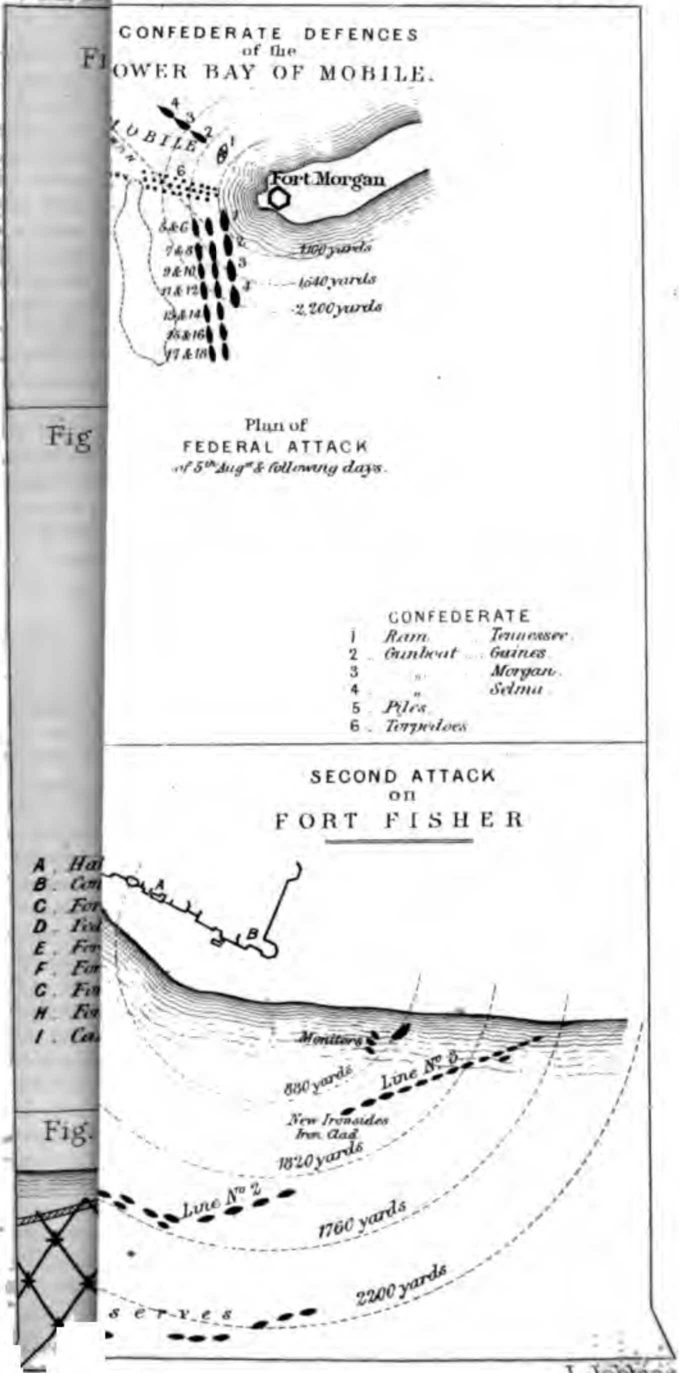
The crew of a 15-inch gun consists ordinarily of 14 men, but the gun may be worked with 8. Some officers prefer the smaller number a being equally efficient, and giving more room in the turret. The allowance of projectiles is limited to about 150 rounds per gun. Al 15-inch shell are fitted with three fuze holes, to take 3½, 5, and second fuzes; when the range is shorter than the range of shortes fuze, all are uncapped, otherwise the fuze suited to the distance i uncapped.

CHARLESTON.

Diagram (Plate xii, fig. 1) shows the position of the attacking fle of Federal iron-clads on the 7th or 8th April, 1863, and the defences the harbour of Charleston and adjacent islands, marked with red flag The coloured circles are for 500, 1,000, 2,000, and 3,000 yards. The were two lines of obstructions. The outer one, between Fort Sumter a Sullivan's Island, was made in lengths of strong rope netting suspend from hempen hawsers, and was buoyed with casks, the hawsers bei anchored at the extremity of each section, and the netting weight at the bottom very much like a seine. The inner obstructions (Fig. were composed of a double row of timber pilings, which were cover by the guns of the batteries in rear of the obstructions. If there we any torpedoes in position they were not brought into play; or they fail from their early and imperfect construction to assist in the defence.

The Government at Washington greatly over-rated the endu ance and offensive powers of the iron-clad fleet, consisting of th "New Ironsides," seven monitors, and the "Keokuk," and with whic Admiral Dupont moved up from the anchorage inside the bar on th afternoon of the 7th of April, 1863, with the intention of taking up position off the N.W. face of Fort Sumter, and reducing that fortifica tion in a few hours.

The order for the attack appears to have emanated from the Nav Department on the 6th of January, for on that day Mr. Gideon Welle writes to Admiral Dupont, "that several additional iron-clads had bee "ordered, and are now on the way to join your command to enable you


CONFEDERATE DEFENCES
of the
LOWER BAY OF MOBILE.
Fort Morgan
1100 yards
1640 yards
2,200 yards
Plan of
FEDERAL ATTACK
of 5th Augt & following days.
CONFEDERATE
1 Ram Tennessee
2 Gunboat Gaines
3 " Morgan
4 " Selma
5 Piles
6 Torpedoes
SECOND ATTACK
on
FORT FISHER
Monitors
880 yards
Line No 3
New Ironsides
Iron Clad
1820 yards
Line No 2
1760 yards
2200 yards
Fig
Fig.

J. Jobbins

o enter the harbour of Charleston, and demand the surrender of all ts defences, or suffer the consequences of a refusal."

[n his detailed report of the action, dated the 15th of April, and ich will be found in the Secretary of the Navy's report for 1863, miral Dupont says :—

' No ship had been exposed over forty minutes, and yet in that brief period, as the Department will perceive by the detailed reports of the Commanding Officers, five of the iron-clads were wholly or partially lisabled, disabled too (as the obstructions could not be passed), in that which was most essential to our success—I mean in their armanent or power of inflicting injury by their guns. . . . . . .

[was convinced that persistence in the attack would only result in the loss of the greater portion of the iron-clad fleet, and in leaving nany of them inside of the harbour to fall into the hands of the nemy."

There were mounted on the Federal iron-clads that participated in s action, and which, except the "Ironsides," were presumed improvents upon the original "Monitors," the following guns :—

Smooth-bore.				Rifled.		Total Guns.	Number of Fires.
15-inch.		11-inch.		150-pr. Parrot.			
No.	Charge.	No.	Charge.	No.	Charge.		
	lbs.		lbs.		lbs.		
7	35	20	15 & 20	3	16	30	139

Of the total number of shot fired, the "New Ironsides" delivered ;ht. In the smoke and tideway of the Channel, she seems to have come on this occasion utterly unmanageable, and had to anchor twice save herself from going ashore, never having been able to bring her ns to bear on Fort Sumter, but directing them on Fort Moultrie and ttery Wagner. The Officers of the Monitors experienced great ficulty in managing their vessels, and keeping them clear of each ier and the bottom, with the limited field of vision, the look-out holes the pilot-house, afforded.

The guns and charges employed by the Confederates were as follows, d you may rely upon the authenticity of the statement, as I have ken it from General Ripley's official report, under whose command re the immediate defences of Charleston harbour, who perfected or signed the best of the earthworks, and under whose anxious superion the troops were organized and prepared for battle.

RETURN OF GUNS AND MORTARS AT FORTS AND BATTERIES IN CHARLES[TON] HARBOUR, APRIL 7TH, 1863.

Calibre.	Smooth-bores.				Rifled Guns.			Mortars
	ins. 10	ins. 9	ins. 8	prs. 32	ins. 7	ins. 7 light	ins. 6·4	ins. 10
No. of guns ..	10	3	19	18	2	7	8	9
Charges ..	15 lbs.	10 lbs.	10 lbs.	8 lbs.	15 lbs.	8 lbs.	6 lbs.	5 to 10
Weight of shot.	128 „	90 „	65 „	32 „	120 „	70 „	64 „	90
Number of fires	385	80	736	343	86	140	366	93

Total number of guns of all calibres	76
Do. „ fires „	2,229
Do. „ pounds of powder used	21,093
Greatest charge of powder	16
Do. weight of shot	130
Average charge of powder	10

We will now refer again to the Federal official reports, to learn the amount of damage done to their iron-clads by the fire from the Confederate batteries; and that you may justly estimate the effect of that fire, I must ask you not only to bear in mind the comparatively light charges and projectiles employed, but to remember that none of the latter were either chilled or of steel.

I read from a report drawn up by six of the Commanding Officers of the Monitors, and which is published with the Secretary of the Navy's report for 1863.

"1st. 'Passaic.' A large piece of brassing under turret broken off, "owing to which, and its being forced over, the turret could not be "moved for some time, and has not worked well since. The gun-"carriage of the 11-inch gun disabled until the next afternoon, and "the top of the pilot-house forced up, so as to expose the inside to "shot, and not got in place until late the next day.

"2nd. 'Weehawken.' Side armour broken through, exposing wood "The flange supporting gun-platform broken, smoke-stack very much "injured, and both this and the turret greatly weakened from loss [of] "bolts, the latter for a time stopped.

"3rd. 'Patapsco.' Rifled gun disabled at fifth fire, smoke stac[k] "penetrated in several places through upper part of armour, out [of] "which were forced forty bolts, rendering the whole structure ver[y] "insecure until strengthened again, besides this the turret had be[en] "stopped for a time.

"4th. 'Nantucket.' 15-inch gun lost at third fire, owing to a blo[w] "on turret jamming the port stopper, which could not be moved after-"wards. The turret stopped several times, besides severe injury t[o]

oke-stack and deck. The concussion box in this short time lost ht bolts, and the turret was made to move with great difficulty.

5th. 'Nahaut.' Lost seventy-six bolts from the turret and pilot-ıse, the latter very much injured. The steering gear deranged, l the plates started. The braces that hold down the inner gun cks, and brace of turret knocked off, and turret rendered im-vable, and not cleared until 5 o'clock the following afternoon. Even present, after long repairs, it can only be made to revolve very wly, with thirty pounds of steam."

eaking of the Monitors generally, these Officers say :—

The liability of the guns to become disabled on occasions which quire steady use, has been shown, as well as that the turret almost ariably refuses to work after receiving heavy blows from shot, t only because the consequent bulging-in injures the machinery, t from its being pushed from the perpendicular."

ie "Montauk" was hit fourteen times, but received no material ıge; she was commanded by Captain Worden, who says :—

Had the attack been continued it could not have failed to result in aster."

ie "Catskill" was struck "some twenty times, but without any ous injury. The 'Keokuk' was struck 90 times, and completely led, and sunk after the action, her guns falling into the hands of Confederates. She differed from the Monitors in many essen-points."

hese were the experiences obtained by the Monitors after an action, ch lasted so short a time, that the Confederates considered it ly a preliminary attack. Yet, although they revealed defects in details of their construction, particularly, I think, in their laminated ets, and armour, and in the central spindle system of revolving the ıer, still we must remember, that although these seven vessels were 256 times, the least number received by any one being 14, and the ıtest 53 times, the list of casualties was insignificant.

pposed to ordnance considered powerful against unarmoured sels, there is no evidence to show that either the hulls or the tur-of any of the vessels, except the "Keokuk," were penetrated by t. Yet wooden vessels, placed in a similar position, would have e to inevitable grief. Nevertheless, had the Confederate fortifica-been armed with either steel, or steel and wrought-iron guns of no ıer calibres than 8 and 9 inches, firing Major Palliser's lancet-led chilled projectiles, with charges of 30 and 43 lbs. of powder, it y conviction,—if I may be permitted to have one,—that the whole iitor fleet would have shared the fate of the "Keokuk."

ort Sumter, you are no doubt aware, is a brick structure, with two s of casemates, and a battery *en barbette*. The walls were 5 feet thick he faces of the arches, and 12 feet between the arches. The effect, ording to General Ripley, of the 15-inch shot, at distances of from 00 to 1,500 yards, was a greatest penetration of 30 inches—twice diameter, and a mean penetration of 15 or 18 inches. Where two t struck the face of one casemate, a crack extended through, and, truck once or twice more, in the same place, would have breached

the casemate. Fire of the iron-clads very slow and fairly accurate. Estimated distance 900 to 1,900 yards. The Federals estimated the range at which the action was fought, at from 550 to 2,100 yards. The position of the fleet on the chart is a compromise between the two estimates. After the repulse of the fleet, no further attempt was made to pass the fortification, and take the city by a naval force; not even when General Gillmore had got complete possession of Morris Island, and reduced Fort Sumter to a shapeless ruin—a ruin which I am sure you will pardon me for reminding you, a gallant garrison held until Charleston was evacuated in the winter of 1865. Admiral Dahlgren, who relieved Admiral Dupont, in command of the fleet off Charleston, expresses himself generally satisfied with the endurance and efficiency of the Monitors, which were under his command for a period extending over nearly two years. In a written opinion of their performances, he says:—

"The force of a 10-*inch* shot (spherical) must be experienced to be "appreciated. Any one in contact with the part of the turret struck "falls senseless, and I have been nearly shaken off my feet in the "pilot-house when engaging Moultrie.

"All the little defects of details were marked by such a searching "process. Decks cut through; cannon worn out; side armour shaken; "tops of pilot-houses crushed, &c. But all these were repairable, and "no vital principle was touched."

The services of the Monitors after their repulse by Fort Sumter, were confined to assisting General Gillmore in his siege operations against Fort Wagner, an earthwork mounting seven guns on its seafaces, and which the Monitors and the "Ironsides," although frequently attacking, were unable to reduce, so that it could be assaulted successfully. I take it, that the experiences at Charleston go to show that the turrets of the Monitors of the "Passaic" class, which are 11 inches thick, in 1-inch plates, can be disabled, but not penetrated, when struck fairly by a 10-*inch* spherical, or 7-*inch* rifled shot of cast-iron, with charges of 16 lbs. of powder, at distances not exceeding 1,000 yards.

"The heavy shot fired," says Admiral Dahlgren, "which have "struck, have generally been 10-inch, and are well borne at 1,200 yards, "but when the distance is less than 1,000 yards, there is a marked "difference."

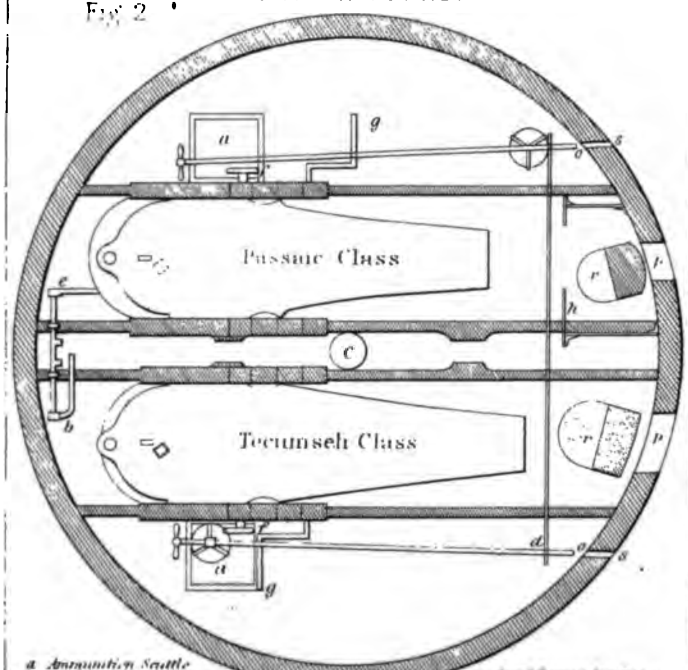
In the operations against Charleston, it must be borne in mind, that the Monitors had a harbour of refuge at Port Royal, sixty miles off, whither they could go to be repaired, and where one or more of them were always in the hands of the engineers detailed to look after them. Without Port Royal, they could not have continued their operations against Charleston for three months.

Capture of the "Atlanta."

Not long after the attack on Sumter, the Monitors, "Weehawken" and "Nahaut," captured the Confederate iron-clad "Atlanta." This vessel was originally a Clyde-built screw-steamer, which was diverted

MONITOR TURRET

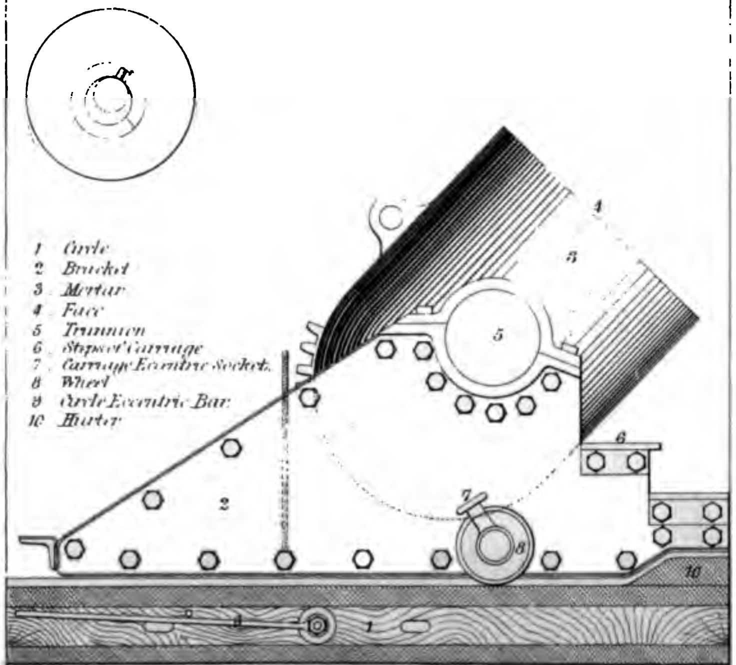
Fig 2.



- a Ammunition Scuttle
- b Starting Bar for revolving Turret & training Gun.
- c Shaft on which Turret revolves.
- d. Travelling Bar on which move the shell whip.
- e Position of Engineer to revolve Turret & train Gun.
- f Compressor Wheel.
- g Crank for running Gun in and out.
- h Smoke Box.
- o. Officer at sight hole.
- p. Port hole, r Port stopper.
- s. Sight hole.

MORTAR

Fig 1.



J. Jobbins

her peaceful pursuit as a trader on the west coast, and put to ig the blockade. Arrived at Savannah, she was converted into on-clad, somewhat after the manner of the "Merrimack." In vouring to go from Savannah to Charleston, she got aground in f the sounds on the coast of Georgia, and in that predicament ttacked by the two Monitors. The "Weehawken" appears to done most of the work. She fired five shots at distances of 300 , four of which hit, two being 15-inch, and two 11-inch.

15-inch cored shot struck the side of the casemate on a line the port-holes. It broke the armour completely through, although urse was somewhat oblique. The wooden backing was much ered, and several bolts were withdrawn from their places. It large hole entirely through the plating and backing, *although the tself did not go through.* Forty men were knocked down by the ers and concussion of this shot, and more or less injured. Sixteen found to be seriously wounded, of whom two or three died.

e armour of the "Atlanta" was four inches thick, in two plates o inches each, bolted to an oak and pine roof pitched at an angle °, and which was 18 inches thick. Her armament was two h and two 6·4-inch cast-iron rifled guns.

the Monitors employed during the war at Charleston, the "Wee-en" went down at her anchors inside of Charleston Bar. The ief in this case seems to have been done by the entrance of water e base of the turret, and through the hatches, hause-pipes, &c. e time the wind was fresh from the N.E., but there was not much n.

e "Patapsco" was destroyed by running on a stationary torpedo, sunk her in less than thirty seconds. Sixty-two of her officers nen went down with her.

e speed of the Monitors of the "Passaic" class, with clean ms and smooth water, is about 7 knots; but when the bottom nes foul it falls to 3 and 4 knots. They turn quickly and in less than most vessels.

Mobile.

Mobile you will see, by referring to the chart (Plate xii, fig. 4), that ral Farragut's fleet consisted of fourteen wooden vessels and four tors, carrying 125 guns. In the first order of sailing, the wooden ls were lashed in couples, the heaviest vessels being nearest Fort an, and covering the four leading pairs of vessels, were the four tors. The Admiral did not consider it necessary on this occasion to upon the fort a preliminary bombardment, his object being simply ect the passage of its guns, to cut off communication with the town obile, and to leave the reduction of the fort to the Army with guns, assisted by shelling from the fleet when in possession of ay. The passage was made by all the fleet in 45 minutes from the of weighing anchor, and with the loss of but one vessel, the tor "Tecumseh," destroyed by a torpedo. Fort Morgan mounted uns, the heaviest being 10-inch columbiads.

After passing the fort, the Admiral was about to anchor his fleet, when he discovered the "Tennessee," commanded by Admiral Buchanan, bearing down upon him. He immediately made signal to such vessels as he thought suitable to engage her. The "Monongahela," a wooden 7-gun screw steamer, was the first to strike her, and in doing so, carried away her iron prow, together with her cut-water. The "Lackawanna," 7 guns, struck her next, at full speed, but though her stem was cut and crushed to the plank ends above and below the water line, the only perceptible effect on the ram was to give her a heavy list.

The "Hartford," flag-ship, wooden, 21 guns, was the third to strike the "Tennessee," the blow was a glancing one, but as she rasped along the iron-clad's sides, she poured her whole broadside of 9-inch solid shot into her, within ten feet of her casemates.

"The Monitors," says Admiral Farragut, "worked slowly, but de-" "livered their fire as opportunity offered. The 'Chickasaw' succeeded "in getting under the 'Tennessee's' stern, and a 15-inch shot from the "'Manhattan' broke through her iron plating and heavy wooden "backing, *though the missile itself did not enter the vessel.*"

The Admiral says, "that when the 'Tennessee' surrendered she was "sore beset. The 'Chickasaw' was pounding away at her stern, the "'Ossipie' was approaching her at full speed, and the 'Monongahela' "and 'Lackawana,' and this ship (the 'Hartford') were bearing down "on her, determined on her destruction. Her smoke-stack had been "shot away, her stearing gear was gone, and several of her port "shutters were jammed; indeed, from the time the 'Hartford' struck "her she did not fire a gun. Admiral Buchanan was wounded in the "leg, and two or three of his men were killed, and five or six "wounded.

"Our iron-clads, from their slow speed and bad steering, had some "difficulty in getting into and maintaining their position in line as we "passed the fort, and in the subsequent encounter with the 'Tennessee' "from some cause were not as effective as could have been desired."

From the official reports of the Officers commanding the Monitors we learn that the "Winnebago" was struck nineteen times, three shot having penetrated the deck. The after-turret broke down completely.

The "Manhattan" was hit nine times, causing no material damage. The 15-inch carriage was injured by the recoil of the piece.

The "Chickasaw" was struck a number of times, one shot penetrated her deck.

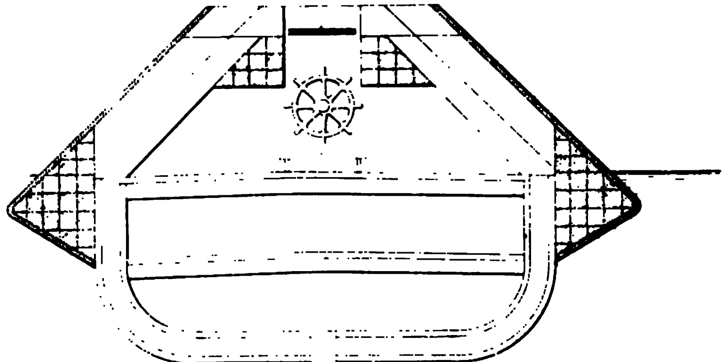
On board of these three vessels there appear to have been no casualties.

The "Tecumsech," as I have already stated, was destroyed by a torpedo, and with her were lost Captain Craven, a very accomplished and gallant Officer, and most of her crew.

In the wooden vessels the Federals lost 52 killed and 170 wounded. Most of this loss was inflicted by the guns of the "Tennessee."

The "Tennessee" (Plate xiii) was a vessel built after the "Merrimack" system, with the addition of the knuckle or over-hang. The hull was of oak and yellow pine with iron fastenings. Length on deck 209 feet, beam 48 feet, draught of water 14 feet. The casemate was strongly built, 79 feet long, 29 feet wide inside, the sides of the vessel extending 10

x 15 Inch Shot



Section thro' Pilot House — Confederate Ram Tennessee.

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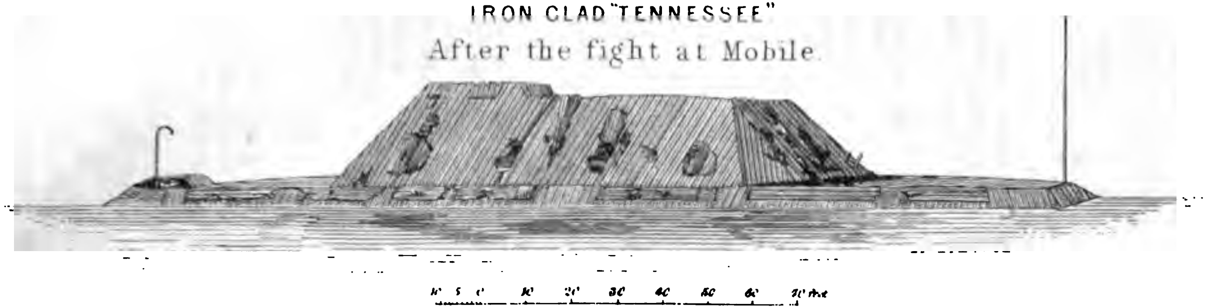
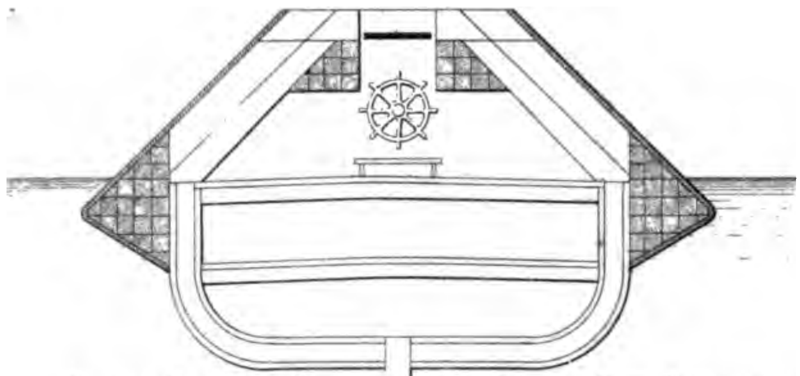
IRON CLAD "TENNESSEE"
After the fight at Mobile.



× 15 Inch Shot



Section thro' Pilot House. Confederate Ram Tennessee.

J. Jobbins

set from it at the greatest breadth of beam. The sides and extremities of the casemate were made of stout timbers and planking of pine and oak, making a total thickness of backing of 25 *inches*, upon which was placed armour plating 6 and 5 inches thick, in single plates of 2 inches and 1 inch thick. The slope of the casemate was 30°.

The "Tennessee's" armament consisted of 7-inch and 6-inch cast iron rifled guns, firing respectively wrought-iron bolts of 133lbs. with 6lbs. of powder, and similar bolts weighing 94lbs. with 12lbs. of powder, which seemed to produce but little effect on the Monitors.

It perhaps should be mentioned that the sides of the wooden ships were protected with chains, which seem in most cases to have prevented the complete penetration of shot and shell fired against them.

No shot except the 15-inch shot seems to have sent splinters into the casemate of the "Tennessee," in fact, it was the only shot which penetrated to the timber backing. Nine 11-inch solid shot struck within a space of a few square feet in the immediate vicinity of a port; the armour plating was started, bolts driven in, but none of these shot seemed to be able to get into the timber.

The 11-inch guns were fired with solid cast iron and steel shot, and 20 pounds of powder. The 15-inch guns, solid shot, cored shot, and shell, with 35, 50, and 60lbs of powder. The 100-pounder and 150-pounder rifled guns with chilled bolts, and 10lbs. and 16lbs of powder respectively.

The "Tennessee" bore no external evidences of the injury inflicted upon her hull by the ramming of the wooden ships, and had she been more manageable as a ram, and been armed with heavy smooth-bores instead of inefficient cast-iron rifle cannon of small calibres, she would, in the estimation of her captors, have made a better fight.

Her chief defects were in her exposed steering gear, and her motive power. Her engines were taken from a river steam-boat, and by much ingenious management induced to turn her screw. The shooting away of her funnel filled the gun deck with smoke, and half suffocated her crew, already stunned by the ramming of the wooden ships, and blinded by the blast of bursting shell. Could she have got clear of the corvettes, she might have stood a better chance with the Monitors, of whose service in the action the Admiral does not seem inclined to be enthusiastic, and for whom he did not wait to commence battle.

Effects of Torpedoes on Monitors.

After occupying the lower portion of Mobile Bay, the Federals lost two Monitors by torpedoes. One had a hole ten feet in diameter knocked through her forward, and the other sunk in three minutes.

The torpedo is peculiarly fatal to the monitor class of vessel. Their sides not being on an average more than 18 inches above the surface, the remaining floating power of the "Passaic" class, which are 844 ton O. M., is not according to Admiral Goldsborough's estimate more than 200 tons. In action everything is battened down, and the chances of egress from below and the gun ports of the turrets are very few. The hatches have to be lifted from below with levers, which have to be found and applied at a time of more or less panic or confusion.

The only true Monitors destroyed in battle during the war were by torpedoes, and of these three were sunk at Mobile and one at Charleston. It seemed easier to blow a hole in their bottoms with roughly constructed torpedoes than to penetrate their turrets and hulls with the ordnance necessity forced the Confederates to use.

The same want of resources which told against them so fatally in the creation of a fleet, prevented their employing a simple and efficient system of self-acting electric torpedoes.

Wilmington.

The Chart (Plate xii, fig. 5) shows Fort Fisher at the entrance of Cape Fear River, and the key to the defences of Wilmington, the port most used in the war as a depôt for blockade-running.

Fort Fisher was built entirely of sand, and its guns 46 in number were mounted *en barbette* between traverses, and in casemates. The sea-front extended in a direct line about 1,200 yards, and the land front, as it was called, 550 yards. The land along the sea-coast of the Southern States is low and sandy, and resembles in its general features the coast of Lancashire, from the mouth of the Mersey towards Southport.

The guns on Battery Buchanan, and those in depôt, were not used in the second bombardment against the fleet, and should not be included in estimating the effective armament of the defences.

The United States' Army Engineers state, that there were only 12 guns in position of any value against iron-clads, and the heaviest of these were the 10-inch columbiads, and two 8-inch cast-iron rifled guns. One was a Blakely gun (at point B), rifled with three deep grooves, and had flanged projectiles on Captain Scott's system. The Federal and Confederate reports agree in stating, that this gun was the most efficient of the armament of the fort brought into action. It was taken, marked by the enemy's shot, and stained with the blood of its cannoniers.

There was mounted on the sea-front, at the point A, an Armstrong 150-pr. shunt gun, but which, as you will see, did not bear on the iron-clads. It was amply provided with steel shell to be fired with charges of 30 lbs. of powder, and which no doubt, had they struck the side armour or turrets of the monitors, would have subjected them to a test they never yet have experienced. The gun is now mounted at the United States' Military Academy at West Point, as a trophy.

The attacking fleet, as you have seen by the chart, which is enlarged from that published with Admiral Porter's report, consisted of forty vessels divided into three divisions of wooden ships, numbered from left to right. At the head of the third division was the "New Ironsides." The four Monitors occupied a position in-shore, and in advance of the 3rd Division, and at a distance of between 1,000 and 800 yards from the land-front of Fort Fisher. There were anchored outside of the attacking fleet, three divisions of reserves, composed principally of paddle steamers, and were intended, I presume to afford

any assistance required to the vessels actively engaged. The total number of guns mounted in the fleet was 617, of which 275 were available in the bombardment:—"The contrast between the two "armaments is striking," says General Abbott, of the United States' Engineers, "and shows that without mortar fire, or heavy iron case- "mates, the land guns had little chance of success."

"We expended," says Admiral Porter, "50,000 shells, and have as "much more on hand. All the guns facing the ships are dismounted "or injured, so they could not be used, or the muzzles were filled up "with sand or earth, which rendered them useless. I only saw two "that were not rendered useless. I believe we have burst all the "rifled guns left in the fleets, and I think the reputation of these guns "(Parrot's) is now about ruined."

The Monitors were all struck several times without receiving serious injury, except in one or two cases to their decks. On board of the "Saugus," one of the 15-inch guns burst, but only one man was wounded. The turret was not injured, and the firing was continued with the remaining gun. The "Mohopac" also burst her 15-inch gun. The piece went a little more than four feet from the muzzle, that is, a few inches within the turret, doing no injury to the latter, or to the men inside of it. I think these experiences are valuable. First, they show us that 15-inch guns do sometimes burst like all other guns; and, secondly, that the bursting of a gun within a turret has not such a terrible result as the opponents of Captain Coles's system would have us believe.

Admiral Porter's Opinions.

Admiral Porter has written a despatch on the result of his experiences with vessels of the "Monitor" class, and upon American ironclads generally. This you will find published with the report of the Secretary of the Navy for 1865. Few men have had a larger experience in modern naval warfare than he has, and I must say, from my personal knowledge of his attainments, that I accept his opinions on subjects relating to naval affairs, with a confidence not given to any other Officer in the United States' Navy.

The Admiral, after expressing both his gratification, and almost surprise, at the good weather the "Monitors" had made in riding out a gale at their anchors off Wilmington, goes on to speak thus of the "Monadnock:"—

"She is certainly a most perfect success, so far as the hull and "machinery are concerned, and is only defective in some minor details, "which, in the building of these vessels, require the superintendence "of a thorough seaman, and a practical and ingenious man."

Of the other Monitors he says:—

"These vessels have laid for five days under fire from Fort Fisher, "anchored less than 800 yards off; and though fired at a great deal, "they were seldom hit, and received no injury. Compared with the "'Ironsides,' their fire is very slow, and not at all calculated to silence

"heavy batteries, which require a rapid and continuous fire to drive "men from the guns, but they are famous coadjutors in a fight, and "put in the heavy blows, which tell on casemates and bomb-proofs. "The smaller class of monitors, as at present constructed, will "always require a steamer to tow them, and to take care of them. . . "I do not know what their real durability is, or would be, in a continuous fire against their turrets. Solid 11-inch or 200-pounder "rifle shot are apt to break something where they strike, and I should "be much better satisfied myself to be behind wooden bulwarks, and "take what comes, than to be shut up in an iron turret, not knowing "whether it is properly constructed. This, though, is the prejudice of "a sailor, and should have no weight whatever.

"I have only to remark that the principle is a good one, if the "vessels are all built like the 'Monadnock.' The fire of these vessels "continued with such vessels as the 'New Ironsides,' and heavy frigates "is very effective, particularly against heavy-plated vessels, bomb-"proofs, and stone and brick walls. I have never yet seen a vessel "that came up to my ideas of what is required for offensive operations "as much as the 'Ironsides.' She combines very many good qualities. "The most important is the comfort with which the people on board "of her live, though she would be no match for the 'Monadnock' in a "fight, the latter having more speed."

I must remind you that the "Ironsides" was a partially armoured broadside vessel, carrying fourteen 11-inch 7½-ton guns, and two 150-pounder Parrot rifles. Her speed was, I believe, about seven knots, that of the "Monadnock" about ten knots.

Present Naval Forces of the United States.

The American Navy at present consists of 278 vessels, mounting 2,351 guns. Of these, 55 are iron-clad Monitors. The American Congress has authorized the selling of a number of these latter, which will leave not more than 20 Monitors in the Service of the following classes:—

	Tonnage. O. M.	Guns.		Thickness of Turret.
		Number.	Calibre.	
Dictator	3033	2	20 inch	15 inches.
Kalamazoo ..	3200	4	15 "	15 "
Monadnock ..	1564	4	15 "	12 "
Canonicus ..	1034	2	15 "	11 "
Passaic	844	2	15 & 11 "	11 "

None of these vessels are at present in commission.

Writing in 1864, and previous to the completion of the monitors of

the "Kalamazoo" class, the Chief of the Bureau of Construction says:—

"For the protection of our coast and harbours we are probably well "prepared, but we have only three vessels that can pretend to cope "with the sea-going iron-clad vessels of European nations, and these "have not yet been tried. It is a problem to be yet resolved, whether "a large steam-vessel with her deck a foot or two above water and "without sails, can be effective, and use her guns as a cruizing ship.

"Until such time as it becomes the policy of the Government to "build iron-armoured vessels for sea service, and whenever com"menced, it will require some years to have them in sufficient num"bers to keep an enemy from our coast; we must have recourse to "plating wooden vessels, of which the first cost is less, though it is "certain to be more expensive in the end.

"Until we have armoured sea-going ships, we must give up the "expectation of engaging our foes on the ocean, and must limit our "operations to attacks on their commerce."

Mr. Lenthal, the Chief Constructor, and Mr. Isherwood, the Engineer-in-Chief of the American Navy, in a joint communication addressed to the Navy Department in March, 1862, and which they submitted as an expression of their opinions to the "Committee on the Conduct of the War," in March, 1865, and to which opinions they state they still adhere, advised the building of wooden armour-clad vessels, with twin screws, fighting their guns in turrets revolving on their circumferences, instead of on a central spindle. These gentlemen conclude their letter thus,—

"Harbour defences are indeed valuable adjuncts, and should not be "neglected, but they cannot constitute a Navy, or perform its proper "functions.

"If ever assailed by a powerful maritime foe, we shall find, if ready, "how much better it is to fight at the threshold than at the hearth"stone."

The Monitors of the "Monadock" and "Kalamazoo" classes, represent to some extent the suggestions of Mr. Lenthal and Mr. Isherwood. These vessels are made of wood, and have no overhang; their turrets, however, are of unbacked laminated armour, and are mounted on Mr. Ericsson's central spindle system, and not on Captain Coles' system, as at first advised by these gentlemen.

It needs, however, no great penetration to divine the future naval policy of the United States. It is to hold its coast and harbours safe from blockade and attack, by the creation of a numerous fleet of powerful monitors and torpedo boats; one of these latter of 116 tons, has already found its way into the Navy List. With the coast secure and the harbours open, the ocean is to be covered with a swarm of swift cruizers, and letters of marque. Hence the production of the "Wampanoag" for the cruizer, and the "Puritan" for the protector.

If the "Wampanoag" is not an "Alabama," *par excellence*, it is because she was built under an erroneous conception of what such a ship ought to be.

American Ordnance.

I regret that in disposing of the vast amount of material at hand, and not being skilled in the process of literary digestion, I have left myself no time to enter into the details of the experiences of the war with the ordnance employed. Captain Fox, then Assistant Secretary of the Navy, in his evidence before "the Committee on the Conduct of the War," states distinctly (I quote his own words), "*We have got* "*to come to wrought-iron and steel guns, and abandon cast-iron.*" I need hardly say to you, that Captain Fox was not only in a position to form a correct judgment by sifting the opinions of others, but his previous education as an Officer, and his attainments as a practical and scientific man, make his opinions worthy of serious consideration, and I think we may safely conclude, that the cast-iron guns of the American Navy are a temporary substitute for guns of steel or wrought-iron, or both combined.

Some experiments have been instituted at Washington by the Army Engineer Bureau, to ascertain the value of the ricochet fire of the 15-inch gun. The results of these experiments are given with great minuteness by General Abbot, in a paper published by authority of the Secretary of War, and which is re-published in a very useful and interesting work by the former, entitled "Siege Artillery in the Campaigns in Virginia." His general conclusions are given in a tabulated form, which clearly establish the fact, that even with this calibre, ricocheted fire is worthless against iron-clads. Hence efforts have been made to substitute for the heavy smooth-bore gun, a 12-inch rifle gun cast in the same mould and in the usual Rodman manner. The projectiles have grooves cut in them, so that they are locked with the gun, and cannot get out without rotating.

The bore of the gun, of course, is ribbed to correspond with the grooves in the shot, and, I believe, the ribs are three in number. This gun has been fired 400 times with charges of 45 and 55 pounds of powder. As the gun weighs 23 tons, and the shot 600 pounds, the charge of powder is light in comparison with that of the Woolwich 600-pounder, which is, I believe, 70lbs., and more notably to that of guns manufactured of Firth's steel, which have fired 500-pound shot with charges of 60lbs of powder, the gun weighing but 16 and 18 tons.

In 1864, there were three of these 12-inch rifle guns cast for experiment by the Navy. I have not seen any published results of those trials. After the painful experiences of that service with cast-iron rifle guns, its officers will be cautious in again committing themselves to that system.

Hence for fighting armoured vessels a 13-inch solid shot smooth-bore gun, weighing about 15 tons, and firing a 280-pound shot with fifty pounds of powder, and a 130-pounder 10-inch gun weighing about 7½ tons, and fired with 30 pounds of powder, have been introduced into the Service in lieu of the 15-inch and 11-inch shell guns.

The present charges for the 15-inch Navy gun, as authorized by the United States' Ordnance Instructions for 1866 are as follows: For dis-

tant firing 50lbs., for ordinary firing 35lbs. At close quarters against iron-clads 60lbs. and a solid shot of cast-iron (worked and poured in a peculiar manner), *may* be fired for 20 rounds.

The 15-inch shell weighs ..	..	..	330lbs.	
And carries a bursting charge of ..		..	13	„
The *cored* shot weighs	..	..	400	„
The solid shot weighs	..	..	452	„

The two 15-inch guns which burst at Wilmington were fired with 35lbs of powder. As the instructions for inspecting the vents of all guns during and after firing is religiously observed, we have no data by which to judge of the actual endurance of these guns, for whenever there is an indication at the vent of approaching dissolution, the gun is at once withdrawn from service.

We have seen in the cases of the "Atlanta" and "Tennessee" that the 15-inch shot did not pass through the backing of their slanting but imperfect armour, although the distances were in neither case more than 300 yards, and in the latter the charge was 60lbs. There can be no doubt that a similar shot upon the "Manhattan's" turret would have knocked it entirely off its centre.

Conclusion.

In conclusion, I have only to ask you not to understand, from anything I have read you, that I disapprove of the "Monitor" system as a system. As faulty as many of the American "Monitors" may be in the details of their construction, the principle is a sound one at its core, and for transporting heavy guns in shallow water, and fighting them under such circumstances, I can conceive of no vessels which would surpass them in efficiency and invulnerability, *provided* they were built with solid armour, wood backing, and Captain Coles's turrets.

Looking to the experiences of the American War, I think we must admit that, whenever the Monitors have more nearly resembled Captain Coles's system, their performances have been best—at sea and in battle, as in the "Monadnock;" and, on the other hand, where the difference between the two systems has been *greater*, as in the case of the "Weehawken," the defects have been most palpable. Although the Monitors may not be very habitable vessels, still the evidence of the Chief of the Bureau of Medicine and Surgery is conclusive as to their healthfulness. On board of the "Montauk," for a period of 164 days prior to May, 1865, there was but one case of sickness—yet in warm weather the heat is very great in the turret and stoke hole—to be attributed to the perfect ventilation by artificial means.

If I may judge from the expression of the official opinions of the Officers of the American Navy, I would say that the tendency is not to depend solely on turret ships in the composition of the fleet, but to have such ships as "coadjutors in a fight," as Admiral Porter says, to put in the occasional heavy blows, with the more rapid fire of the

lighter guns of the broadside vessels, even if those vessels can be but partially protected with armour chains or other devices.

I trust that the facts and opinions I have had the honour of placing before you this evening, have been of sufficient interest to repay you for the trouble you have been to in coming here to listen to the reading of this paper. If the conclusions which I venture to draw are erroneous, I need only say I am anxious for correction.

I take it they may be thus condensed:—

1st. Fixed fortifications without obstructions are powerless under ordinary circumstances, to prevent the passage of a swift and powerful fleet.

2nd. Floating batteries to fight such a fleet, must be quicker in turning, of light draught, and unexceptionable rams.

3rd. The placing of one or two floating batteries in a harbour, and depending on them to destroy a fleet, which is capable of passing a regularly constructed fort, is but an invitation to disaster, and a delusion which should be dispelled by the fate of the "Tennessee" at Mobile. Under similar circumstances it would perhaps be safer to rely on a fleet of nimble musquitoes, like the "Staunch," with their 300-pounder stings, than upon an invulnerable, but sluggish iron-clad battery.

4th. The power of an enemy's fleet to inflict injury, can only be completely neutralized by a fleet of similar magnitude, and capable of making counter demonstrations. All temporary substitutes for such a fleet cannot keep your coast free from blockade, your harbours secure from the danger of surprise, or even an enemy from landing on your shores.

5th. A free people in arms, although deprived of many of the necessities of war, may form a formidable Army to repel invasion, but the creation of a fleet is the development of years of patient experience and careful organization, the offspring of a prudent foresight, rather than of the exigencies of unexpected war.

6th. It is wiser to concentrate the resources of a country on the fortifications of the principal forts and arsenals, so as to secure them against capture, than to expend the same resources on many comparatively unimportant points, which from their isolation and weakness invite attack, and afford to an enemy the opportunities of obtaining cheap victories.

7th. Guns mounted *en barbette* in open earthworks, cannot keep down the fire of a well handled and numerous fleet, or prevent its passage. To fight such batteries, we require a rapid and concentrated fire of broadside vessels to silence an enemy's fire, while either making the passage of such batteries as at New Orleans, Vicksburg, and Mobile, or to enable the turret vessels, with their slow and precise fire, to dismount and destroy an enemy's most formidable guns and defences, so that the work may be carried by assault, as at Wilmington.

8th. Monitors like those at Charleston cannot reduce a fortification like Fort Sumter, with smooth-bore guns, even of 15-inch calibre. Because to make these guns efficient against such fortifications, they must approach within ranges at which such Monitors cease to be suffi-

ciently invulnerable to supersede siege batteries of rifle guns, like those employed on the land, and with which General Gilmore reduced the same work to a ruin at distances of from 4,000 to 3,000 yards. Nor can Monitors, so deficient of speed as those employed at Charleston, run the batteries of a fort, unless they are attended by broadside vessels, to keep down the enemy's fire with shell, grape, and shrapnel, as was done at Mobile. No Monitor has yet been subjected to the fire of a gun as powerful as the 9-inch Woolwich gun.

9th. When it is possible to do so, the scene of action should be removed from your shores, and the enemy's fleet attacked before it gets within gun-shot of your defences. To do this at this day, an iron-clad sea-going fleet is absolutely necessary, equal in all respects to that of your enemy. Such a fleet this country can obtain sooner than any other, for you have the money, the iron, the skill, and the labour to build such a fleet, and if I have read aright the history of your Navy, the men to fight it intelligently and courageously.

10th. And lastly. As it is quite evident that no European power has on one hand an armoured fleet of sufficiently light draught to operate successfully on the American coast, and, on the other, as the Americans themselves have no sea-going iron-clads other than a few Monitors to cross the Atlantic, to make war on this side of the water, we may conclude that the hydrographic inequalities of the two continents are so many guarantees for peace: or at all events, in case of such a war, the operations at sea will be mostly conducted in wooden ships, acting as independent cruisers.

Commander W. Dawson, R.N.: Mr. Chairman, as far as I gather from the applause which greets Captain Hamilton on his sitting down, I am sure that I do but express our united opinion that we have heard a very interesting, clear, and able paper, this evening. I have been very much struck with the exact nature of the facts and figures which Captain Hamilton has brought before us. Many of those figures, when read out from a paper, are naturally somewhat dry to listen to; but when they appear in print in our "Journal," the communication, I think, will be found one of the most able that has adorned that "Journal" for some time. Those who have read and studied carefully the official despatches to which Captain Hamilton alludes, and which are published with the Reports of the Secretary of the United States' Navy, must have been struck with the remarkable rise and progress of that Navy from almost nothing, from a very low state of organization, without ships, without guns, without men. Suddenly, the whole force was created; and we must not be surprised if a force so created, was not very perfect in the constructive department. I do not think myself, from what we have heard from Captain Hamilton to-night, that we have much to learn in the constructive department, from the—I might almost say *late*—United States' Navy, for, according to Captain Hamilton, it has almost passed out of existence. But it was wonderful to me on reading those despatches to see how much was done with such imperfect tools. It reflects very great credit on the Officers of the United States' Navy and their seamen, that they were able to effect so much with such ships and such guns. I think the secret of it was, that they had not that fear of responsibility which naval men in this country labour under, whose actions, if not altogether successful, have to pass through a very severe criticism at home. Captain Hamilton did not tell us that when the Flag Officer Dupont was beaten back from Charleston, he received a telegram from the President to go in again, and wait for further orders. Fortunately, he was not in a condition to do so; but that spirit of determination at head-quarters that something

should be done at any cost, was, I think, the great cause why the Officers felt themselves untrammelled by responsibility as to what their superiors would think, provided they fought the enemy. I wish to bring to your notice one point with reference to three of those plans before us. Captain Hamilton told us with regard to the plan of New Orleans, and I quite agree with him, that if there be a clear channel through which ships—be they of wood or iron, and propelled by steam—can get past, no forts in the world would ever stop a determined enemy, provided he can get to a point of safety beyond those forts, and provided there is a sufficient object to be attained by passing them. At New Orleans there was a raft formed with chains and vessels, moored across the channel; but it was so imperfectly constructed, that when the United States' Officers boarded that raft, they had simply to cast off the chains, and then there was a passage created, through which the vessels passed. In the case of Mobile we observe the same thing. There was an obstruction across a great part of the channel; but there was an opening within 200 yards of Fort Morgan, and in consequence of that, the ships were able to pass through. There was one torpedo, unfortunately, in the way, which sent the "Tecumseh," an iron-clad, to the bottom, with the loss of her crew, except some eight or ten Officers and men. Now, if you look at the plan of Charleston, why was it, I ask, that for a course of three years, a fleet was anchored off there, which was not able to get in, to pass those batteries and turn them? why did it remain outside? It was simply, at least I can only explain it on that ground, because that channel was obstructed, not only at the entrance but above Fort Sumter. It was obstructed carefully, not only by those ropes to which Captain Hamilton has alluded, but also in a very great degree by torpedoes. When Admiral Dupont went in there, in April, 1863, the "Ironsides" anchored over a torpedo, about 1,000 yards off Fort Wagner.

Captain HAMILTON: About 3,000 yards from Fort Sumter.

Commander DAWSON: She was anchored over a torpedo, which at the right moment was to have been fired by electricity, but which failed to go off, and she was saved. If all the torpedoes were like that, there was not much to fear from them. But according to these despatches, the Americans, in the course of the war, lost 26 vessels, besides 8 or 9 injured, by torpedoes; in fact, they lost more from torpedoes than from any other cause during the whole course of the war. The channel at Charleston was obstructed by torpedoes both inside the harbour and at the entrance. They might have been imperfect, but they did their work well by keeping the enemy out. They not only destroyed the "Housatonic" and "Patapsco," but after the place was actually captured, three or four Federal vessels were severely injured by these torpedoes. It is only by obstructing the water-way in some way or other, that is to say, by torpedoes, or passive obstructions, that you can prevent an enemy's ship passing forts and getting into a point of safety beyond, provided she has a sufficient object before her to tempt her to do so. I will not touch further upon the point of torpedoes, except to say that their utility in obstructing a channel appears to me to come out very strongly in these three plans of forts; for there seems no reason why the Federals should not have got into the other places, and should not have got into Charleston were it not on account of the torpedoes and other obstructions in the passage. It is true that in passing forts, the Federals very often lost their ships, as at Fort Pittsburg; but then they had a sufficient object to attain, and the loss of a few ships was of no consequence compared with the great results to be achieved in putting an end to the war.

Rear-Admiral SIR FREDERICK NICOLSON, Bart.: I am sure that we all agree with the remarks of Captain Dawson, that it is very rarely that we hear in this theatre a lecture which conveys a greater amount of information. It is information of that valuable class which we so much require; not merely experiments made at Shoeburyness or at other places, but the results of actual warfare. There is one point brought out by Captain Hamilton, to which I wish for one moment to direct your attention. I cannot help expressing my regret that we did not hear this paper before the two projects of moveable circular forts, and circular ships of war were brought before us on previous evenings. The point is, the unmanageable character of some of the American vessels from want of speed, or, in other words, from want of power in their engines. I do hope that inventors, when they ask seamen to adopt these extraordinarily shaped floating bodies we have seen models of here, will recollect

that in a narrow channel, in fact in any channel where there is a strong tide, vessels of that kind must be unmanageable; and that, unless we have a sufficient speed, I might also add, unless the vessels are of moderate size as to length, such vessels are unhandy. I think we can all understand, at least all seamen can thoroughly understand, that a Commander going into a narrow channel with four or five unmanageable vessels, cannot be in a very comfortable position. I cannot help thinking that the handiness of vessels is apt to be lost sight of in the attempt to make them invulnerable, and also to carry enormous weights, whether of armour-plating or of guns, thus obliging the constructor to make them of these peculiar shapes. I think Captain Hamilton only confirms us in what most of us know respecting the rare ability of Captain Coles. I remember having a conversation with Captain Coles, when some of the failures of the turrets were first known in this country; and I remember his pointing out to me, as it has been pointed out to-night, that his turret did not revolve on the spindle, but upon the circumference, and that jamming could not happen with his turret. I was cognisant of his first turret on board the "Trusty," when it was severely tested, and I was much struck with the fact, that though that turret was very much battered, it was perfectly manageable and in perfect working order at the end of the experiments. I am sure we are all glad to see Captain Hamilton here to-night, and as he says there are other points which he wished to bring before us, I only hope we shall have the pleasure of meeting him here again on another occasion.

Captain Maury (late C. S. Navy): I merely wish to avail myself of this opportunity to bear my testimony to the exceedingly valuable and interesting paper that Captain Hamilton has given us. He has spoken of events with which I am very familiar. I was, as it were, mixed up with those affairs, in fact, at the beginning of them, very much so; and I can bear testimony to the accuracy with which he has given his statements and figures, and the accuracy with which he has gone through all the details. There is one point upon which I should like to put in a little caveat. On one side we had everything to improvise. We had nothing. I went to Richmond when the "Merrimac" was at the bottom of Norfolk harbour; and one of the first things we did, was to raise that ship. All the powder that was in the Confederacy, except blasting powder, consisted of such as had been taken out of the magazine by a very few Officers, whilst in the north one night. A short time before the battle of Manasses was fought, I had a note from General Lee to say that unless I could furnish him with percussion caps, he should have to withdraw our army from the field. We had 40,000 percussion caps, and the machines with which the caps were made that fought that battle, were manufactured between the 18th of April and the day of the battle—the machines and the caps both. So it appears to me that the marvel is that, with the naval resources on the one side and the total absence of them on the other, though a great deal was done, yet a great deal more might have been done. That more was not done, was not because of torpedoes, but because of the fear of torpedoes. The only place in the whole Confederacy that was properly defended by torpedoes was Richmond. We had no wire; we had no insulated wire; we had not even the electric instruments to use for setting off the torpedoes. I had despaired of getting anything; but fortune turned in our favour. An attempt had been made on the Federal side to lay a submarine cable in Chesapeake Bay. It parted; ten miles of it was within our lines, and with that wire the James River was defended. There were no torpedoes at Wilmington. You recollect that that first attack, made by Admiral Porter and General Butler, failed, on the plea by Admiral Porter, that he dared not enter for fear of torpedoes. There were no torpedoes there. There were not many torpedoes in Charleston; at least, if there were, they were mechanical torpedoes.

Commander Dawson: They were principally mechanical torpedoes at Charleston.

Captain Maury: They had no means of testing those torpedoes at Charleston, to know whether they were or were not serviceable. The James River torpedoes were tested every day; they blew up vessels that came within distance. The last one that was blown up, was the Commodore Jones. At Mobile they had a great number of mechanical torpedoes. I afterwards saw one of the Officers who was there, and he told me that he used to hear them going off in the night; the fish would strike against

them, or the swell would wash them against the shore, or a log would strike against them; so that when he put down those torpedoes, he did not know whether they would be there when wanted. Again, I desire to add my thanks to Captain Hamilton, and my admiration for the very clear, graceful, and perspicuous manner in which he has given us this account.

Commander DAWSON: I wish to ask one question. I shall be obliged by your explaining how the "Keokuk's" turrets were worked?

Captain MAURY: I do not think they were turrets, they did not revolve.

Commander DAWSON: They were fixed towers?

Captain MAURY: Yes.

Captain HAMILTON: Perhaps I could explain the reason why the Federal fleet did not pass into Charleston. I think it was purely a military reason. The defences on Sullivan's Island were perfectly untouched to the last, there was never a gun dismounted. That whole island, which is about five miles long, was one fortification. Even after the Federals occupied Morris Island, and Fort Sumter was reduced to a ruin, though there was a fort quarried out of the ruin and 10-inch columbiads mounted on it, yet if the Federal fleet had passed those slight obstructions it would have had to encounter the whole of the line of interior defences, which, during the time it took General Gilmore to destroy Fort Sumter, had been made stronger than the exterior line. Even if the Federals had got off the city, the whole of that side of the city was fortified; they could simply have got into the harbour, and could have done no more to the city than General Gilmore was doing every day.

Commander DAWSON: They could have gone into Ashley river had it not been obstructed?

Captain HAMILTON: They could not have gone into Ashley river, it was fortified. General Ripley is here who defended Charleston, he could tell you as to that.

The CHAIRMAN: Perhaps General Ripley would explain.

General RIPLEY: I did not intend to say anything with regard to the defences of Charleston, but the question has arisen why the Federal fleet did not pass. I think Captain Hamilton has given the correct reason. We had very few torpedoes at first. The torpedo to which he referred some little time back which the "New Ironsides" lay over, was for some time the only one down. There were reports given out of a great many torpedoes, in fact flags were placed about the harbour, and particular cautions were given to all vessels to pass through certain channels, simply, not to avoid torpedoes, but to avoid where they ought to have been, where we should like to have had them, if we had possessed the materials to make them. Afterwards we got down a good many stationary torpedoes, and after we had received a supply of insulated wire, a good many electric torpedoes were put down. But the reason why the enemy did not pass at Charleston was, that there was no rest for them; if they had passed the outer batteries they would have come within another circle of fire, which was formed by the north-western face of Fort Sumter, Fort Johnson, Castle Pinckney, and Fort Ripley. Had they succeeded in passing these, they would have been in the centre of another circle of fire, composed of a number of batteries, placed on the wharves of the city, on the shore of James Island, and extending up both banks of the Ashley and Cooper rivers. Some of the batteries are not placed on the chart, but some of the heaviest guns we had, were on the interior batteries. We were so confident about the affair that at one time a message was sent by some prisoners who had been exchanged, that if Admiral Dahlgren would send four of his best vessels inside, they could pass the outer batteries, but if they ever got out again was quite another thing. We never heard any more of the challenge. The whole policy of the defence rested on the principle of making the outer batteries only the first crust; the farther the enemy got in the worse off would they have been. The Ashley and Cooper rivers were made so bad for a fleet to enter, with the number of batteries we had, that it was almost impossible for them to pass the city. That was one thing which they really feared more than anything else. They had information, of course, of everything that was going on. It was the guns and the number of artillerymen who had been kept constantly at work for years, and who knew every gun, that did the business. I really think that, if General Lovell at New Orleans had had the opportunity, which we had, of fortifying the banks of the river for seve-

s above the forts, so that after the Federals had passed Fort Jackson and Fort Philip, they had been subjected to the fire of guns of such a calibre as we had, the fleet would have been turned back. No set of forts can be expected to , where there is a good channel, a fleet of fast going steamers, whether iron-clad vood, when it is done all at one rush, when it can be done at the rate of eight en miles an hour, and as they run past one point decreasing their range every nent, and taking advantage of their concentrated broadside to protect themselves to fire close charges of grape from their guns. But if they find that the further y go for a number of miles, the worse it is, and that they have to keep up the t for an hour or so, the probability is that they will not attempt to pass the side. That was the system of defence which was adopted by General Beauregard Charleston. I had the honour of serving as second in command throughout the le of the siege, and that was the principle we adopted, to make the interior as ng as the exterior. The heaviest guns we had were mounted in the city; they e 600-pounders. There were two there, besides a number of guns which had been rovised into 10-inch rifles, capable of throwing shot of 250lbs. They answered eedingly well; they were not the best guns that could be made, but they were best we could get. We never struck a "Monitor" with any shot over 120lb. ept once, then a rifled ball weighing 250lb. from a 10-inch gun struck one of them n the pilot-house and shattered it all to pieces. It was the last time that we any encounter with the "Monitors," for after they found that we had guns of this bre, they always kept out of the way. I believe that is the answer to the point t has been put.

Commander Dawson: With reference to one point, when you say you had no torpoes, I understood you to say that you had one at Admiral Dupont's attack?

General Ripley: We had one at Admiral Dupont's attack.

Commander Dawson: Afterwards?—In 1864?

General Ripley: We laid them down at different times. We obtained a quantity nsulating wire.

Commander Dawson: But you had a quantity of torpedoes down, and a quantity dy to put down in 1864?

General Ripley: We had a good many down, and many ready to put down, but y were not of the best construction.

The Chairman: Have you any remarks that you wish to make, Captain Hamilton?

Captain Hamilton: I have only to thank you for the very kind manner in which have been pleased to receive the paper I have had the honour to read. Its preation has not been a painless task. The mere references to places and persons e revived the memory of aspirations now relinquished, and have brought back to the faces of dead men once dear to me, and who fell under both flags, as men o speak English always fight, with their whole hearts, for the cause they think t.

The Chairman: It wanted, certainly, not these few words which we have heard t now to increase our admiration of the instructive lecture which we have had m Captain Hamilton. I think we may congratulate ourselves on having heard of the most interesting lectures that has been given here this session, and we y also say that the manner in which it has been delivered, has produced a very at impression upon us. If there was anything wanting to increase the interest of s lecture to us, it will be the recollection, that these gentlemen, who fought on h sides in this war, were nationally connected with ourselves. Here, luckily, in s Institution we have nothing to do with politics, but we can never shut our eyes the high qualities which were shown in this contest on both sides. It would be ficult to find a contest where on both sides, whatever the motives were, the contest s carried on with an ability and a patriotism which is worthy of our admiration, r respect, and our warm feelings, whatever we may think of the politics on either e. We cannot but admire the talent, the bravery, and their devotion to the cause ich each side espoused, believing that they were acting for the welfare of their ntry. We have to thank most sincerely not only Captain Hamilton but General pley and the other gentlemen who have favoured us with their remarks. I will w introduce Captain Colomb, who will explain Lord Caithness's gravitating npass and Mr. Nunn's apparatus for lighting the compass at night.

THE EARL OF CAITHNESS'S GRAVITATING COMPASS AND NUNN'S IMPROVED BINNACLE LIGHTS.

Commander COLOMB, R.N.: Mr. Nunn has asked me to explain the compass for him, as he is content to confine himself to producing good things, leaving the description to others. Lord Caithness has taken it, that while we are paying great attention to the scientific adjustment of compasses, we are losing sight, to a certain extent, of a matter which is immediately under our hands. His idea is, that the oscillation of the card in bad weather throws out the course of a ship considerably, and that the side movement of the points, renders steering very difficult; and we know this as a familiar fact, that in heavy weather for instance, in running before the wind we do sometimes make courses so different from the dead reckoning, that they are set down to the presence of extraordinary currents, which sometimes take us in directions we do not expect. His Lordship has accordingly devised an arrangement to get rid of a great deal of this oscillation, if not the whole of it. At present, as is well known, the compass is hung upon jimbals. The jimbal is really equivalent to hanging a weight at the end of a long lever, the curve of one jimbal forming the length of that lever. The consequence is, that any vibration on the deck of a ship is transferred, in an accelerated degree, to the bowl of the compass, and there is always more or less tremulous motion. He proposes to fit the compass, instead, in a ball and socket joint, the bowl being counterbalanced by a heavy weight. (Fig. 1.) You thus have the bowl of the compass placed on a solid block, which forms part of the ship and has no vibration except that which is in the ship itself. When a compass hung in this manner was tried, as it has been, against those hung in the ordinary way, the difference was very remarkable; there was no perceptible oscillation of the compass in the heaviest weather, whereas, in the compass which is jimballed, there is a very considerable oscillation. The weight is below, and there is room enough in the base of the binnacle for the roll of the ship to 35 or 40 degrees.

Mr. Nunn has also taken up another department, viz., the lighting of the compass; and this is also a most important matter, as we all know, because very often where the compass is badly lighted, the man steering loses the points, makes mistakes, and does not steer his proper course. Mr. Nunn has invented the lamp now before you. (Fig. 1.) In the ordinary way, the lamps are placed at the side, and they throw the lights sideways on to the compass, and never give complete illumination. In this one, the light is placed at the top, in a sort of parabola-reflector; the light is thrown down on the card, but gives no light outside the binnacle; the oil vessel, also, being hung upon jimbals, there is no spilling of oil, and this is not an unimportant matter on board a man-of-war, because we know that there are under the present system almost always permanent little clots of oil near the bin-

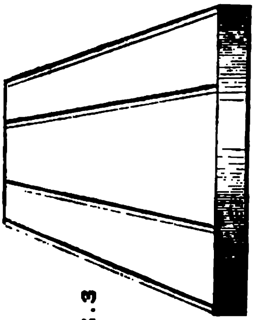


FIG. 3

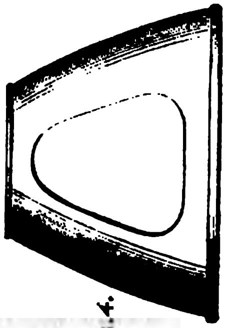


FIG. 4.

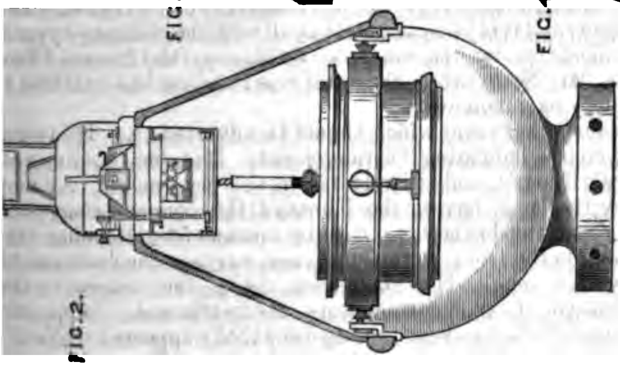


FIG. 2.

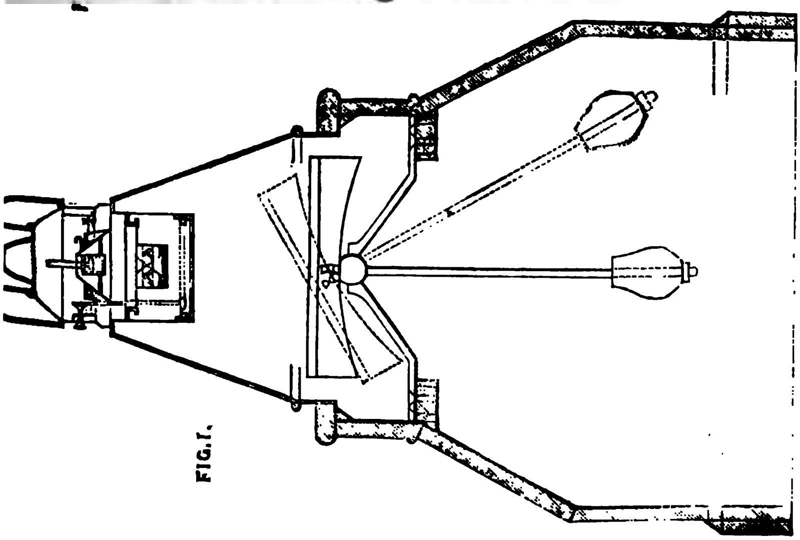


FIG. 1.

nacle, from the oil spilt from the rolling of the ship. He has also made an arrangement for taking cross bearings by night at sea. This arrangement (Fig. 2) consists, first, of a copper bowl fitted with brackets to receive the ring of the Azimuth Compass; on the top of the bowl is a ring to which is attached a tripod having another ring at the top to fit the outer ring of the lamp. Outside the tripod and fitting over the lamp is placed a hexagonal cover (Fig. 3), with six panes of glass, again outside of this is a metal shade (Fig. 4), having an aperture in it to show the compass card. At night the two outside covers or shades are removed, and the lamp remains in the same position supported by the tripod. This enables the Officer to get at the sights of the compass and work it with the same facility as in the day time, the light being all thrown on the card, and at the same time being confined in the lamp there is no possibility of its being blown out. This improvement is a most important one, as it enables you to take accurate bearings at night; and this you cannot do at all with the ordinary system. It was one called for by the masters of ships in the Channel Fleet. I described to Mr. Nunn what the want was; and he has fulfilled it, I think, in a very excellent way.

There is yet one other point which should be adverted to. It is what is called "the course indicating" arrangement. It is due to a suggestion of Admiral Ryder's, and is likely to prove very useful. A band, illuminated by the lamp, having the points of the compass engrossed on it, travels round inside the lamp case by means of a detaching key. A single opening in the front of the lamp case, exposes one point and no more, to view at a time. The Master on giving the course to the Officer of the watch, at the same time sets this instrument. Supposing the course were E.N.E., he turns the key till E.N.E. appears "E.N.E.," and he takes the key away. It remains a register of the course to be referred to; it is impossible that there can be any mistake afterwards, as nobody can touch it, the Master having possession of the key.

The sketch before you (Fig 1) shows you a binnacle fitted with Lord Caithness's gravitating compass, and Nunn's improved light and course-indicating arrangement.

The CHAIRMAN: We return our thanks to Mr. Nunn for what he has done, and to Captain Colomb for explaining the apparatus to us.

LECTURE.

Friday, April 24th, 1868.

[AJOR-GENERAL THE HON. JAMES LINDSAY, Vice-President, in the Chair.

COOKING FOR TROOPS.

. Lecture prepared by Commander FREDERICK WARREN, R.N., and read by the Secretary.

OME apology is necessary for a Naval Officer taking upon himself the eading of a paper under such a title. It should rather have been a 'system of cooking for large bodies of men with economy in food and 'fuel"—but as the system has been adopted into the Army, the itle it is hoped will not appear presumptuous. It was originally itended that this paper should have included some remarks on 'Cooking for Troops in the Field," but circumstances have obliged its eing limited to cooking in barracks, and here I think I cannot do etter than quote from a pamphlet that has been written on my cooking pparatus.

"In introducing a new cooking apparatus, which claims perfect novelty f invention, and introduces a new system of cooking, combining great conomy of food with an extraordinary saving of fuel, and which, after ong-continued and most careful trials at Aldershot, has received the nqualified approval of the authorities, some few words explanatory of s construction and capabilities are necessary.

" First, as to the new system of cooking. It has long been an dmitted fact, that a large amount of the nutritious matter contained ι food is lost in the ordinary process of cooking, either by roasting or oiling.

" To avoid this waste, Captain Warren invented, two years ago, an pparatus of simple construction, which not only prevented loss, but t the same time attained the desirable result in the culinary art, of reserving to every kind of meat its own flavour.

" To effect a revolution in the art of cooking may at first sight appear ifficult; but when it is stated that by the new system, the viands re cooked without coming into immediate contact either with water, team, or fire, something is asserted which invites attention to the ubject.

"The meat is put into an inner chamber, the outer case of which is heated by steam, or water kept at boiling point, and is cooked entirely in its own vapour. None of its nutritious properties are allowed to escape, nor one particle to be wasted.

"It is well known that meat, cooked by roasting or boiling, loses a large portion both of its bulk and weight, and also some of its most nutritive qualities. Therefore an invention which, after repeated trials, is proved to be capable of avoiding these defects, and of cooking perfectly, must necessarily have a claim to public approbation.

"On the 28th of April, 1865, this invention was severely tested in the kitchen of the Cambridge Barracks at Portsmouth, under the superintendence of the master cook of the 26th Regiment, and in presence of Major-General Lord William Paulet, K.C.B., and the Officers of the Staff. The following is the substance of the result of the trial:—

"The rations of fifty-six men were placed in a vessel made of block tin on Warren's plan, and at the same time rations for fifty-five men were put into a boiler which was at hand.—Time 8·45 a.m.

"Six pounds of meat were also placed at the same time in two smaller tin vessels, fitting into ordinary saucepans, on the same principle as the boiler, and cooked on the kitchen grate, whilst 12 lb. of meat were simultaneously placed in the new baking oven.

"At 12·30, the rations above mentioned were taken out of the respective apparatus in which they had been cooked, and were served to the troops.

"On testing the rations that had been boiled, there was a marked superiority in those cooked in Captain Warren's apparatus. The soup was of a decidedly richer flavour, and the meat more moist and tender than that cooked in the Government boiler.

"As regards the comparison of the baked rations, the superiority rested with those cooked in Captain Warren's pots. On comparing the weight of the rations when removed from the respective baking apparatus, the result was as follows:—12 lbs. from the baking oven, were reduced to 8 lbs. 2 ozs.; 12 lbs. cooked in two pots of Captain Warren's, each holding 6 lbs., were reduced to 8 lbs. 10 ozs.—being a gain of 8 ozs. in 12 lbs.

"The meat from Captain Warren's pots was better flavoured, more tender, and the gravy, which had no water in it, as was the case with the rations baked in the Government apparatus, was decidedly richer.

"Lord William Paulet satisfied himself of the above results prior to the opinion of the men being taken. On questioning the soldiers to whom the rations were served, the reply was unanimously in favour of the soup, as also of the *bouillé*; of its superiority in quality and substance over the rations cooked in the ordinary manner, there was not a dissenting opinion.

"The experiment was again tried at the same hour the following day, in the cook-house of the 6th Brigade Royal Artillery, at the Gun-wharf Barracks—with this difference however, that as the Artillery prefer baking to boiling, the rations were baked in the following proportions:—weight of meat prior to cooking in either case, 15 lb.

On being taken out, the result was as follows:—Government baking apparatus, 10 lbs. 12 ozs.; Captain Warren's apparatus, 12 lbs. 1oz.,—showing a gain in Captain Warren's apparatus of 1 lb. 5 ozs.

"Lord William Paulet was again present at the serving out, and tested the rations, when the superiority was again awarded to the rations prepared by Captain Warren's apparatus. There was an unanimous expression of preference as regards the quantity and quality of the rations. One of the baking pots was tested on the same day in the sergeants' mess of the 6th Brigade Royal Artillery, and the result met with the approval of the members.

"The report, therefore, was most favourable on Captain Warren's apparatus. Its advantages over the Government method of cooking, appear to be as follows:—

"1. No water is absorbed by the meat in the process of cooking.

"2. Gain in actual weight.

"3. The meat is prepared at a temperature of 210°, which is acknowledged should not be exceeded in preparing the most nourishing soups.

"4. Burning, scorching, over-boiling, and smoking are impossible.

"5. Dressed meat may be kept hot for a considerable time without spoiling.

"6. One set of vessels can be used for either baking or boiling.

"7. The principle might without difficulty be made applicable to cooking in the field.

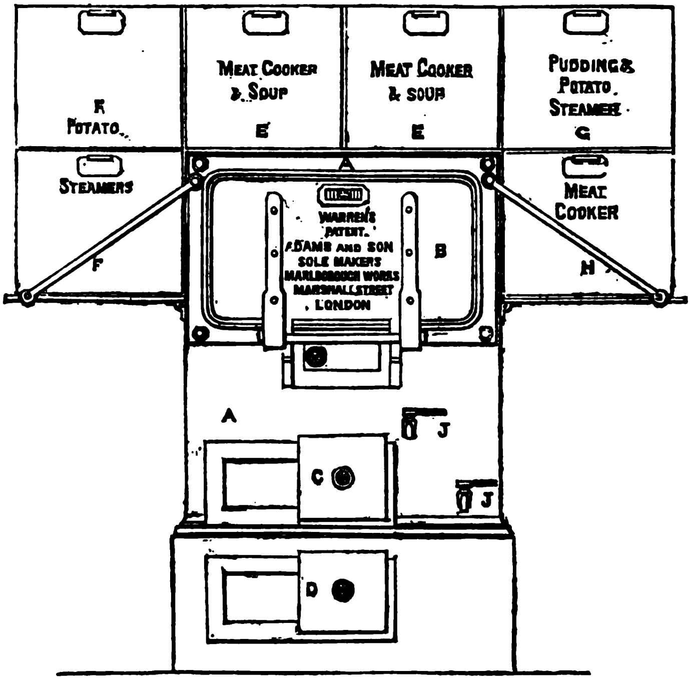
"These *preliminary trials* proved so satisfactory, that further tests were called for, and early in 1866 Captain Warren obtained permission from the Horse Guards to send to Aldershot, for trial, a *complete apparatus* adapted to the special requirements of the Army—one which would not only effect a great superiority in cooking, but also show an immense saving of fuel, besides assisting to establish a system of cooking by companies, or separate messes, so that each soldier might always depend on getting the actual rations served to him, and of having it cooked in a variety of ways. Captain Warren then patented his apparatus shown in the woodcut, which was made under his superintendence, at the works of Messrs. Adams and Sons, and put up by them in the instructional kitchen at Aldershot, and the result of the trials has convinced every one, that no cooking apparatus had ever yet been constructed, which cooked so well, or saved so much fuel. But before giving the reader the statistics of its merits, it may, perhaps be as well to describe in detail the apparatus itself.

"The apparatus consists of two parts; first, the stove proper; and, secondly, the hot air and steaming vessels in connection with it. A is the stove, constructed of wrought iron, and containing two boilers, for supplying boiling water for breakfasts, teas, and washing-up purposes, and for furnishing steam to the cooking vessels; these boilers are so constructed that the fire acts directly on the water contained in them, *no brickwork whatever*, being required either in their construction or in the fixing.

"The fire, after passing through the boilers (which by their peculiar shape form the flues), is then conducted entirely round a roaster or

oven, B, placed over the lower part of the boilers, one of which is continued up behind the back of the oven to the top of the stove. C

Fig. 1.



is the door of the furnace, which is made to slide either to right or left. D is the ash-door, which also regulates the draught into the furnace, the ash-pit being partly filled with water—the boilers are supplied with water from behind; the filling pipes forming also vents, and are furnished with whistles at the top to announce, if necessary, a deficient supply of water. J J the draw-off cocks.

"E E are two of the patent cookers, having inner linings; the bottoms of the outer cases communicate with the steam-boiler below, by means of brass ferrules and cones fitting closely, to prevent any escape of steam. The covers of the cookers are made hollow so as to contain the steam which passes up through the case of the cooker, leaving the interior free from steam, so that the meat is cooked by *hot air* only. Soup is also prepared in these cookers; the meat is placed on a perforated tray above the water or stock, *and not in it;* and the soup receives the droppings of the meat. Thus the meat loses less in weight than by the ordinary method of boiling, and the soup is improved in quality and flavour.

"F F is the potato cooker, and is fitted inside with six potato cans or pots, holding 20 lbs. each, or in all 120 lbs. The potatoes are cooked by steam from the lower boiler (the upper one being reserved for the other cookers), the whole being thoroughly done within 45 to 60 minutes, according to the kind of potato.

"H is a cooker similar to E and E, in which meat is generally cooked without soup; and on testing the weight of the meat cooked in this pot it was found, by weighing it together with the gravy that had run from it, that scarcely any appreciable loss had resulted; a joint weighing 14 lbs. not having lost 4 ounces.

"G is a steamer for steaming puddings, and is constructed to hold twelve or fourteen meat puddings, or dinners for twenty-four men. It can also be used for steaming carrots, parsnips, and other vegetables.

"The oven B is thoroughly ventilated, and will roast full rations for 22 men, including potatoes browned under the meat. It will also bake bread; 12 to 16 lbs. being thoroughly baked in two hours.

"When the apparatus is not in use, the cookers and kettles can be taken off, and placed upon a shelf, the side-plates lowered, the stove then occupies a space of 2ft. 2 in. wide, 3 ft. 7 in. high, and 1 ft. 10 in. deep.

"The apparatus as now made, is calculated to cook for 120 men, or two companies. The following statement shows how this can be done, each mess being kept separate.

Company A, consisting (say) of	60 men, in	3 messes.
Company B, ,,	60 ,,	3 messes.
	Total ..	6 messes.

1st mess.	A full bake, or roast in oven, consisting of joint and potatoes under	20 men.
2nd mess.	One meat pie in oven, or a second joint and potatoes	20 men.
3rd mess.	Meat and soup in top cooker	20 men.
4th mess.	Stew	20 men.
5th mess.	Warrenized meat in right-hand cooker. (This is to be cooked in hot air without water)	20 men.
6th mess.	Ten meat puddings in top right-hand cooker	20 men.
	Total ..	120 men.

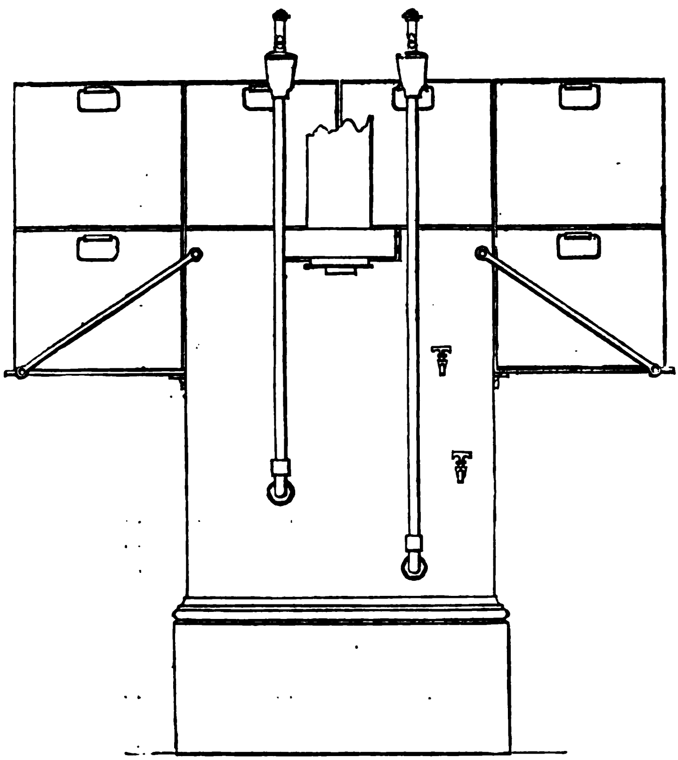
"In addition, 120 lbs. potatoes are cooked simultaneously in the potato steamer. A dish, termed a sea-pie, consisting of meat and paste in layers, can also be prepared in the top cookers.

"The total consumption of fuel for the day for 120 men will be found to average under 28 lbs. Thus a constant daily variety in cooking is obtained, which no system has given before, and this, as will be seen by the reports, at a greatly reduced consumption of fuel."

To fix the apparatus, place the loose stand D upon the ground, in the exact position in which it is intended the apparatus should be fixed; the body A A is then to be lifted upon it; it must then be tilted up at the back, and the ash-pit slid into the grooves under the bottom of the body, and then screwed to the front of the stand with the two screws which are attached to it.

Lay the furnace bars inside the furnace, then put on the two doors C and D—the former with the lining inside, is the furnace door—the latter, without a lining, is the ash-pit door; then screw in the two draw-off cocks J J, with a little red and white lead cement.

Fig. 2.



At the back of the stove (Fig. 2) are two brass screws to which the feeding pipes are to be attached—the longer pipe for the lower screw, the shorter pipe for the upper; these only require to be screwed up hand-tight; the brass feed cups are to be screwed on to the top of the two pipes, and the covers, which are constructed with whistles, should be placed upon them; then screw in the two small gauge-cocks into the holes at the back.

The smoke box is to be placed at the back of the stove, and secured with the two screws; from this, the smoke-pipe may be attached and carried into a flue in any manner most convenient.

The cookers are then to be placed on the stove in the following order:—

The two meat and soup cookers for the top, marked E E, will be known by their having inlets for the steam in the bottoms.

The two potato steamers F F are single-bodied cookers, with six perforated pots inside, and are to be placed on the shelf on the left side, the brass ferrule in the side fitting closely on the cone projecting from the side of the apparatus.

Having concluded the descriptive account of the apparatus, we will now proceed to the reports sent into office from time to time, since the experimental trials at Aldershot, which led to its adoption.

REPORTS.

No. I.

Horse Guards, S.W., *4th March*, 1868.

Sir,—With reference to your letter of the 29th December, I have the honour, by desire of His Royal Highness the Field Marshal Commanding-in-Chief, to forward a copy of a report by a Board of Officers, assembled at Aldershot, to ascertain the saving in fuel, and the reduction in the waste of meat, effected by the process now termed "Warrenizing."

I have the honour to be, Sir,
Your most obedient servant,
E. R. Wetherall, *Deputy Q.-M.-Gen.*

Captain Warren, R.N., Leicester House, Gipsy Hill, S.E.

(Copy.)

Proceeding of a Committee assembled to examine and report on Capt. Warren's Cooking Apparatus, as directed in Horse Guards' Memo., B/b/3808, of the 30th December, 1867.

Members.

Dr. Bacot, Staff Surgeon Major.
Capt. Home, D. A. Q.-M.-General.

The Committee having met, the following points for investigation were agreed on, as being not only embraced in the directions contained in the Memo. above quoted, but also as being interesting and desirable subjects of investigation:—

A.—The time of cooking.
B.—The quantity of fuel used.
C.—The quality of the food when cooked.
D.—The general adaptability for use by soldiers.

1st Experiment.

The meals for an entire company, 47 men, were cooked in Warren's Apparatus and in the usual Deane's boilers and ovens.

1st Experiment.

A.

	Warren.	Deane's boiler.
Breakfast—		
Coffee	45 minutes.	20 minutes.

	Warren's.		Deane's.	
Dinners—	h.	m.	h.	m.
1 Mess soup.. .. .. } 1 Mess stew and potatoes .. .. .. } 1 Mess baked meat and potatoes .. .. }	3	35	3	45
Teas—				
Tea	1	45	1	45
Total	6	5	5	50

B.—*Fuel.*

	lbs.	oz.	lbs.	oz.
Breakfast	6	0	7	0
Dinners	15	8	61	0
Tea	1	8	3	0
Total	23	0	71	0

1 lb. of wood for Warren's Apparatus.
3 lbs. do. for Deane's do.

Note.—Coal used, a very fast burning inland coal. The allowance for 47 men is 50 lbs. of coal.

C.—*Quality of Food cooked.*

In both cases the food was excellent.

D.—*General adaptability for soldiers.*

This apparatus will cook for 120 men; but, allowing a certain margin, it will cook for 100 easily, and will allow of five different messes being cooked in distinct ways, which, in a sanitary point of view, is very valuable. Its use is easily learnt. It is quite safe, easily kept clean, shows dirt to an Inspecting Officer rapidly, can be easily moved from place to place, being in fact, a kind of stove; is less often out of order, and although its repair is more expensive, yet it requires fewer repairs and costs to keep it up about the same as Deane's apparatus, and costs far less in putting up and fitting into a cook-house, and takes for the number cooked for, about one-half the labour to work it.

2nd Experiment.

Two legs of mutton of the same weights, cut from the same sheep, were cooked—one in Deane's boiler, the other in Warren's apparatus.

	Warren's.			Deane's.		
	lbs.	oz.	dr.	lbs.	oz.	dr.
Weight of mutton before cooking ..	7	12	0	7	12	0
Do. when cooked	5	3	4	5	5	0

In the tin with the Warrenized leg of mutton there were 2 pints 15¾ oz. of very strong broth, fit for immediate use, while the water in which the other leg was boiled would have required a large expenditure of fuel and extra ingredients to have made soup at all eatable. The two legs were tasted by several persons, and the universal opinion was that the Warrenized leg was more juicy and better eating than the boiled leg.

With the view of testing still further the value of the process of Warrenizing, the liquor drawn from Captain Warren's apparatus was allowed to cool, and the water in which the leg was boiled was evaporated until it equalled in weight the former and then allowed to cool. It was found that the liquor from Captain Warren's apparatus gave 13 oz. of grease or fat, and the other 7 oz., the former yielding about ½ pint of *very strong* essence of meat, the latter yielding a poor and watery liquor.

.. .. ..

Surmise of these results.

	Warrenized.	Boiled.
Weight of mutton cooked	5 3 4	5 5 0
Fat or grease	0 13 0	0 7 0
	6 0 4	5 12 0
	½ pint of strong essence of meat.	2½ pints of poor liquor.

To determine the saving with different varieties of food that can be made by the use of Capt. Warren's apparatus, would require very lengthened and exact experiments with appliances not at hand.

The following results of the experiments may be recapitulated:—

1. Great saving of fuel.—The Warren Apparatus, with 25 lbs. of inland coal, will cook for 100 men, the allowance for the same number of men being with Deane's Apparatus, 62½ lbs., and with that quantity, baking can only be performed about once a week. Taking all into consideration, and at the lowest calculation, this apparatus will save, perhaps, one-half of the fuel allowed at present.
2. Saving of labour in attendance.
3. Saving of labour and expense in putting up and fixing in cook-houses.
4. A saving of food in an eatable form.
5. An improved quality of food.

(Signed) J. S. W. Bacot, *Staff Surgn. Major.*
(Signed) R. Home, *Capt., D. A. Q.-M.-G.*
Approved.
(Signed) J. Yorke Scarlett, *Lt.-Genl. Comg. Division.*

No. II.

Horse Guards, S.W., *6th March*, 1868.

Sir,—I am directed by His Royal Highness the Field Marshal Commanding-in-Chief, to acknowledge the receipt of your letter of the 28th ult., and to transmit copies of reports received from Colchester, Portsmouth, and Dublin, as to trials of your Cooking Apparatus.

I am to refer you to letter from this office of the 4th instant, relative to recent experiments at Aldershot.

I have the honour to be, Sir,
Your most obedient servant,
E. R. Wetherall, *Dy. Q.-M.-Gen.*

Captain Warren, R.N.,
Leicester House, Gipsy Hill, S.E.

(Copy.)

Royal Barracks, *Dublin*, *8th July*, 1867.

Sir,—I have the honour to return the enclosures received with your communications of the 7th and 15th May and 26th June last; and in forwarding the accompanying reports upon Captain Warren's Patent Cooking Apparatus, tried by the 48th Regiment at Richmond Barracks, Dublin, to observe that I am of opinion that it is the best cooking apparatus I have seen, as it combines much variety in cooking, with less waste and more nutriment in the food cooked.

I would beg to recommend the following additions to the apparatus, viz.:—

1. Proper tin dishes made to fit the oven for baking; the barrack tin dishes now in use are smaller than the space allowed in the oven, consequently a less quantity is baked than could be.
2. Tin cans for tea or coffee, with lids, to keep the liquid hot until required; those now in use are the barrack water-cans—cans without covers.
3. An extra potato-steamer—the number in use allows only 1 lb. of potatoes per

man to be prepared; in some regiments the men wish to have 1¼ lb. per man for dinner, which is the case in the 48th Regiment.

4. I would also recommend the best Welsh coal to be issued for this apparatus; the common kind of coal has been used, and there is no doubt that coal in Dublin is universally inferior to what is supplied in England, therefore 30 lbs. per diem is now necessary.

I have, &c.,

(Signed) A. S. CUNINGHAME, *Maj.-Gen., Com. Dublin Div.*

The Deputy Quartermaster-General, &c., Dublin Castle.

RICHMOND BARRACKS, *Dublin, 1st July*, 1867.

Sir,—I have the honour to make the following report upon one of Captain Warren's Cooking Apparatus, which was handed over to the regiment under my command for trial, and which is found to work very satisfactorily.

The trial commenced on the 7th June, 1867, and 84 men's rations (all the men not on guard of 2 companies) were cooked, but in consequence of the apparatus not being in working order, being quite new, 50 lbs. of coal were consumed, and the oven did not work well, the meat taking five hours to bake properly.

2nd day.—A similar result; the steamer worked very well indeed, and the dinners were cooked splendidly; but again, the oven on this day would not work well, consequently the baked dinners could not be served at the usual dinner hour (1 o'clock), and were not properly cooked until 2 o'clock.

As, however, I thought that there might be some defect in the putting up of the apparatus, it was taken down and placed in different position relative to the draught in the cook-house—the consequence was, the oven worked very well indeed, although 40 lbs. of coal were used on this day.

From the 3rd day's cooking no difficulty whatever has arisen in the preparation of the men's food, although a few pounds of coal more were used than allowed by Captain Warren.

From inquiries, I find the men's food is better cooked by this apparatus than by any other that has come under my observation, and that the meat loses less of its nutriment in the cooking. The men are mostly in favour of the stews prepared by it.

Although after the first three days it will be seen by the diary of the Sergeant Cook that on an average over 5 lbs. of coal were consumed daily over and above that laid down by Captain Warren, yet I am of opinion, that if 25 lbs. of good Welsh coal were used for the apparatus it would be found quite sufficient; the coal used during the trial was ordinary sea coal, and perhaps not of a first class quality.

However, I am confident that the apparatus has succeeded in a wonderful way in preparing the men's food at such a small cost of fuel, and it can be easily worked by one man.

There is one defect which, I think, could be remedied; the apparatus for steaming potatoes is not sufficiently large; soldiers are very fond of potatoes, and generally have (in my regiment) 1½ lb. per day; now, this apparatus would not cook, say for 120 men, 180 lbs. potatoes.

I think that this suggestion should be attended to, in order that a greater quantity of potatoes may be cooked.

After having given the apparatus a fair trial, I find the following results obtained:—

1. The cooking of the meat is better done, and it loses less of its nutriment than by any other apparatus that I have under my notice.

2. A greater variety of cooking is obtained than by any other apparatus which has come under my observation.

3. The very great saving of fuel. I am therefore of opinion that Capt. Warren's apparatus is the best that has been tried by my regiment.

I beg to append the report of the quantity of food cooked by the apparatus from 7th to 30th June, 1867.

I have, &c.,

(Signed) JOHN G. R. APLIN, *Col. & Lt.-Col. Comg. 48th Regt.*

(Copy.)

48TH REGIMENT.

Detail of Cooking done in the above Corps with Warren's Patent Apparatus, from 7th to 30th June, 1867.

RICHMOND BARRACKS, *Dublin.*

Dates.	No. of Messes.	No. of Men.	No. of Bakes Men.	No. of Stews Men.	No. of Soup Men.	lbs. of Potatoes.	Gallons of Coffee.	Gallons of Tea.	Gallons of Hot Water.	Fuel consumed. Wood.	Coal.	Remarks.
7	5	84	24	14	46	90	16	16	12	1	50	The bakes not cooked at 2 o'clock. In oven 5 hours.
8	5	87	24	17	46	100	17	17	14	1	48	
9	5	87	24	17	46	100	17	17	14	1	40	
10	5	86	24	16	46	100	17	17	14	1	35	
11	5	86	23	17	46	110	17	17	14	1	33	
12	5	87	23	17	47	110	17	17	14	1	30	The bakes not cooked properly.
13	5	87	24	16	47	100	17	17	14	1	30	
14	5	87	25	17	45	100	17	17	14	1	30	
15	5	86	24	17	45	100	17	17	14	1	30	
16	5	85	26	16	43	100	17	17	14	1	29	
17	5	85	26	16	43	100	17	17	14	1	30	
18	5	87	24	16	47	110	17	17	14	1	31	
19	5	87	25	17	45	110	17	17	14	1	31	
20	5	87	26	16	45	110	17	17	14	1	30	
21	5	87	24	17	46	110	17	17	14	1	30	
22	5	86	25	16	45	100	17	17	14	1	32	
23	5	86	26	16	44	100	17	17	14	1	30	
24	5	85	26	59	0	100	17	17	14	1	31	
25	5	86	28	17	41	108	17	17	14	1	32	
26	5	86	27	18	41	100	17	17	14	1	30	
27	5	86	28	17	41	100	17	17	14	1	33	
28	5	86	26	18	42	98	17	17	14	1	30	
29	5	87	28	18	41	110	17	17	14	1	30	
30	5	87	29	18	40	108	17	17	14	1	31	
	120	2,070	609	443	1,018	2,474	403	403	334	24	786	

(Signed) E. SPARROW, *Sergeant Cook.*
" JNO. KNOX, *Qr.-Master 48th Regiment.*

(Copy.)

A. A. M. GENL.

Report herewith—

I quite agree with Col. Aplin in his opinion of this cooking apparatus. It is the **most complete** arrangement of its kind I have seen, and its results in cooking are **very satisfactory**, while the saving effected in fuel is of great moment.

I have already reported (in my confidential reports of regiments lately inspected) that the allowance of coal (½ lb. per man) is insufficient for cooking with the present apparatus—that is, it is not sufficient to admit of *baking;* but under Capt. Warren's arrangement there is a saving of 16 per cent. on the otherwise insufficient allowance, and yet the baking is accomplished.

I agree also with Col. Aplin in pronouncing the food to contain more nutriment than when cooked by the ordinary process.

The soup I tasted was excellent.

I believe that with the addition of a third steamer sufficient potatoes might be cooked.

In the event of the boiler becoming corroded, I presume that there would be a way of cleaning it!

(Signed) M. McMurdo, *Br.-Gen.*

2—7—67.

(Copy.)

11 Depôt Battalion, *New Barracks, Gosport, 14th June,* 1867.

Sir,—Captain Warren's cooking apparatus has been in use with the battalion under my command from the 15th May to the present date.

I have therefore, the honour to report that I consider its cooking properties vastly superior to the one in use, "Deane's."

The men's dinners are more varied; they have bakes, roasts, stews, soups, hashes, suet dumplings, or vegetables. The meat is more juicy, and all descriptions of dinners are nicer in flavour. The gravies are richer, being entirely free from adulteration.

The cooking tins are so well arranged that neither water or steam can interfere with the food.

(150) One hundred and fifty men can have on any day their three meals satisfactorily prepared with 28 lbs. of coal, and by the addition of two cooking kettles, which could be placed on the top of the apparatus, its cooking capacity would be increased from 150 to 180, or 200 men, if requisite, without additional fuel.

I have, &c.,

(Signed) Q. Nason, *Lt.-Col. Com. 11th Depôt Battn.*

The Asst. Quartermaster-General, &c., Portsmouth.

B/170.

Portsmouth, 16th June, 1867.

With reference to your Minute of the 6th May last, I submit for the consideration of His Royal Highness the Field Marshal Commanding-in-Chief the report of Colonel Nason, commanding the 11th Depôt Battalion, on the merits of Warren's cooking apparatus, which appears to be very satisfactory.

(Signed) George Buller, *Lt.-Gen. Com. S. W. Div.*

To the Quartermaster-General of the Forces, &c.

Captain Warren's Cooking Apparatus.

4th Depôt Battalion, *Camp Colchester, 26th June,* 1867.

Forwarded to the Quartermaster-General in obedience to the directions contained in his Minute of the 22nd instant. The cook in charge of this apparatus is enthusiastic in his praises of its good qualities, and I must say from what I have seen of it, that the plan is excellent as well as economical.

(Signed) T. H. Tidy, *Col. Com. E. Dist.*

Sir,—With reference to the Quartermaster-General's Minute Paper, dated Horse Guards, 22nd instant, B/1807, calling for a report on Captain Warren's cooking apparatus, which has now been on trial in the 4th Depôt Battalion since the 15th instant, I have the honour to forward herewith a diary of the cooking done with it, and to submit the following as the result of the trial, so far as I have been able to ascertain at present:—

1. The men like it far better than Deane's, and think their meals more evenly cooked and better in flavour, particularly the tea and coffee.

2. There does not appear to be any likelihood of the meals being burnt or otherwise spoilt by ordinary inattention on the part of the cooks, an evil of frequent occurrence under other systems of cooking.

3. The maximum allowance of fuel, 25 lbs. per company of 100 men will, as a general rule, be amply sufficient.

4. The meals of a company mess, or any less number of men, can be kept warm after being thoroughly cooked without deterioration or inconvenience, or interfering with the preparation of evening meal for about two hours, and this without additional expenditure of fuel.

5. The Sergeant-Cook reports most favourably of the apparatus, which he considers in all respects the best he has ever seen in use.

I would beg to suggest the addition of two extra centre tins for the upper boilers, to be used exclusively for tea and coffee; this would be a great improvement.

I have, &c.,

(Signed) GEORGE COXON, *Major Com. 4th Depôt Bat.*

The Major of Brigade, Camp, Colchester.

4TH DEPÔT BATTALION, CAMP COLCHESTER, 25TH JUNE, 1867.

Diary of Cooking done in Captain Warren's Cooking Apparatus, at Camp Colchester, from 15th June, 1867, until 24th June, 1867.

Date.	Breakfast. No. of Men.	Teas.	Dinners. Baked Meat and Potatoes.	Baked Pies.	Baked Meat only.	Soup.	Stews.	Meat Puddings.	Sea Pies.	Potatoes.	Coals. lbs.	ozs.	Wood. lbs.	Remarks.
June, 1867 15th	72	72	..	37	..	35	..	..	..	42	26	4	1	
16th	70	70	..	35	..	..	35	..	..	35	26	0	1	
17th	71	71	..	..	..	..	35	36	..	35	23	0	1	
18th	71	71	..	..	..	..	..	35	36	..	23	0	1	There has been about eight gallons of water drawn out for washing up plates, basins, and cooking utensils daily.
19th	69	69	16	..	..	18	..	..	35	35	25	0	1	
20th	69	69	36	..	..	..	..	..	33	42	25	0	1	
21st	72	72	..	..	27	..	..	10	35	27	23	10	1	
22nd	49	49	..	7	..	..	..	..	42	..	20	0	1	
23rd	51	51	..	..	42	..	..	9	..	42	19	7	1	
24th	51	51	..	9	..	..	..	..	42	..	18	12	1	
Total ..	645	645	52	88	69	53	70	90	223	258	230	1	10	

(Signed) GEORGE COXON, *Major Commanding 4th Depôt Battalion.*

HORSE GUARDS, *November 12th*, 1866.

-With reference to your letter of the 5th inst., to the Lieut.-General Command- Aldershot, I am directed by the Field-Marshal Commanding-in-Chief, to t you that it is conjectured from the experience gained in working your apparatus for 100 men at Aldershot, that it would require from 35 to 40 lbs. n to cook for 200 men.

I am, &c.,

E. R. WETHERALL, *Dep. Quar.-Mast.-Gen.*

tain Warren.

fly, the result obtained is to cook the daily rations of 100 men reatly improved and varied manner, at a cost of fuel of 3*d*. per

vould take up too much of your valuable time to go into the ted results obtained at the Paris Exhibition, where the apparatus hown as the Army Apparatus, and obtained a medal; it is h that the Paris Commissioners remark that—

e patent cooking apparatus invented by Captain Warren, and manufactured liam Adams and Son, of Marshall Street, Golden Square, London, exhibited maker in the English testing-house, and by Her Majesty's Secretary of State r in the exhibition of Barrack Fittings, &c., is one of the most important of this nature in the Paris Exhibition. This object places within the reach British soldier the means of eating his food prepared in a way which far es anything to be met with in any other army. By some unfortunate cir- nce, the Jury (judging by their awards) failed to appreciate the peculiar ex- and originality of these apparatus. Had their labours extended over a period, so that they might have witnessed the trials to which they were sub- there can be no doubt that very different awards to those given, would have ceived by the inventors."—(*Reports*) *Paris Commission.*

all conclude these remarks with a comparative statement of the effected by this system over that now in use.

allowance for cooking is as follows, at home :—

Vhen the old pattern boiler is used, 1 lb. of coal per man per

Vhere the new, or Deane's boilers are in use, ½ lb. of coal per man em.

home establishment shows a total number of no less than 0 men as in the pay of Her Majesty, exclusive of those on the Establishment.

wing for married non-commissioned Officers, and rank and file d with leave, and others married without leave, but who are ted to live out of barracks with the consent of their Commanding , and are consequently also out of mess, a reduction of 25 per (a far larger percentage than really exists), it would leave 0 single men to be cooked for daily at (taking the average of 1) ¾ of a lb. of coal daily.

s—

Coal for 102,000 men at ¾ lbs. per diem = 76,500 lbs.

Coal at same rate for same number of men for 365 days .. .. .. } =12,461 tons.

Same service (100 men being cooked for with 25 lbs. of coal)—

Per diem..	..	..	25,500 lbs.
Per annum	..	..	4,155 tons.

At home it is usual to take the average cost of coal in calculations of this nature at £1 1*s.* per ton. Thus:—

Present system—	12,461 tons	=	£13,084 per annum.
Warren's—	4,155 tons	=	£4,362 per annum.
Difference ..	..		£8,772 per annum.

These figures are based entirely on the published reports.

The item No. 3 (saving of labour and expense in putting up and fixing in cook-houses) in the Committee's Report, marked No. 1, is a very considerable charge, the details of which can only be obtained by a special report; the saving, however, in purchase, fitting and repairs (*vide* Report 1.) will be fully 50 per cent. per annum over the present system of boilers and ovens, and the gross saving to the country by the adoption of Warren's apparatus, including fuel, would be at the lowest estimate from £16,000 to £20,000 per annum, in addition to a saving of labour in attendance, a saving of food in an eatable form, and an improved quality of food.

In conclusion the following extract from the *Morning Star* on a trial at the Society of Arts, may be interesting:—

"*Morning Star.*"—*Dec.* 14.

"Captain Warren's System of Cooking.

"A large number of ladies and gentlemen attended at the Society of Arts yesterday to witness a practical demonstration of Captain Warren's system of cooking for the Army and other large bodies of men. After inspecting Captain Warren's Patent Cooking Apparatus in one of the small rooms of the house, and listening to explanations by the patentee, the company were invited into the lower hall, where were laid out in banqueting style, soups, meats, fowls, vegetables, and other inviting condiments, cooked both according to the ordinary and the 'Warrenized' systems. The company were invited to partake of both specimens of cookery, and come to their own conclusions. They complied with much apparent gusto. In the course of the rather novel proceedings, Captain Warren explained the object he had in view, namely, to obtain economy in preparing food, and economy in fuel. With respect to the first, he had a letter from Mr. Haynes, on behalf of the Committee of the West Kent General Hospital, which stated:—

"'Captain Warren's system reduces the usual loss in cooking from one-third to one-fourth. The figures for two months at this Hospital are as follows:—Old method, meat bought, 959lbs.; waste, 343lbs. Warren's method, meat, 959lbs.; waste, 214lbs., showing a saving of 129lbs. of meat in two months.' This result was mainly at the hospital or at Aldershot by what was now called 'Warrenizing' the meat. It was cooked in such a way that nearly all its juices were retained, and the food was thus rendered not only more sweetened and nourishing, but much more palatable. Taking the experience of the hospital as a basis, if a family of seven persons took daily from the kitchen 10lbs. of meat, the saving of 2oz. per lb. would be 10d. per diem, 5s. 10d. per week, £15 4s. a year. Calculations based upon the trial at Portsmouth, which was conducted in a most searching manner by command of His Royal Highness the Duke of Cambridge, would produce results of an astounding nature if this mode of cooking were adopted by the public; the gain in a national point of view would be enormous. A few

figures will explain this. Thus it was found that 15lbs. of meat was reduced to 10lbs. 12oz. by the process in ordinary use in the kitchen of the Cambridge Barracks, while by Warren's system, the meat was reduced to 12lbs. 1oz., showing a gain of 1lb. 5oz. in each 15lbs. of meat. Now, if instead of cooking for a company of soldiers, we suppose that we are cooking for the 30,000,000 of people that compose this nation, and allowing the consumption of meat at 1oz. per head per diem, and the cost at 8d. per lb., the saving in money would amount to £2,750,000 per annum. With respect to economy of fuel, he had a report of what took place in Paris on the 20th of May last, at a trial for the express purpose of testing the apparatus in that respect. In that trial 16lbs. of coals cooked as follows:—Round of beef roasted, two ribs of beef baked, two legs of mutton 'Warrenized,' two hams steamed, two rounds of beef steamed, soups, potatoes, and vegetables. The apparatus could be readily applied to household purposes on the existing ranges, and at no greater cost, where boilers were already fitted, or where hot plates existed, so that it would be as efficient on a smaller scale in private houses. The saving of fuel would be not only individually, but in the aggregate very large. Taking the average cost of consumption for cooking purposes during the summer months alone, when fires for heating are not required, at 6d. per diem, which Captain Warren said he found was the charge made in lodging-houses, and he believed that might be taken as a fair price, representing 56lbs. of coals at £1 per ton, when that quantity was reduced to 28lbs. it would show for 750,000 houses a saving of £1,700,000 in fuel during that period, or about the cost of one half-year of our Abyssinian expedition. With respect to that expedition, the Captain stated that the weight of the apparatus supplied for practical use was only 146lbs., and they could be transported on the backs of mules or horses. The company seemed to approve very much of the joints and dishes prepared by the apparatus, especially those which were Warrenized."

The Chairman, on returning the thanks of the meeting to Captain Warren (whose unavoidable absence they all regretted) for the interesting paper just read, said that he felt bound to mention the name of one who had been the pioneer in the way of army cooking, and to whom all thanks were due, he referred to Captain Grant, R.A.

Captain Grant returned thanks to General Lindsay and the company for the manner in which his name had been received. He could only add that he had gone carefully into Captain Warren's mode of cooking for troops, and that he had a very high opinion of it.

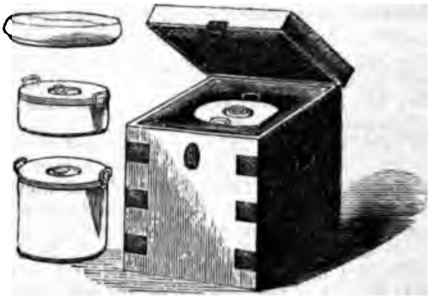
The following provisions cooked in Captain Warren's range were served up to the audience after the lecture, and were by them pronounced to be excellent:—

1 Leg of mutton,	8 lbs. weight,	"Warrenized,"	put in cooker 1.35,	taken out	3.45
1 "	7½ "	Roast	" roaster 1.45,	"	3.50
1 Fowl		Roast	" roaster 2.30,	"	3.40 and kept hot
1 Ditto		"Warrenized,"	" cooker 2.30,	"	3.40 and kept hot
1 Piece of Bacon	4 "	"Warrenized,"	" cooker 1.0,	"	3.50
5 Quarts soup, made with	5 lbs.	beef, herbs, &c.	12.0,	"	3.50
14 lbs. Potatoes		Steamed	" 2.0,	"	3.0 and kept hot

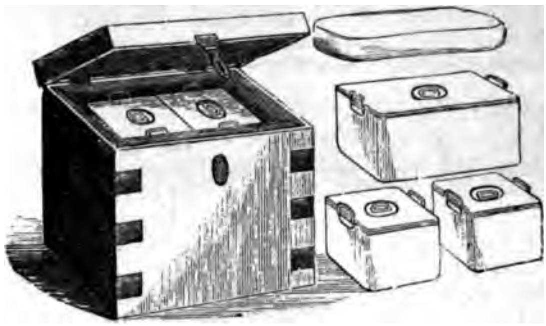
Weight of coals used, about 20 lbs.

At the close of Captain Warren's lecture on cooking for troops, Monsieur Johan Sörensen briefly explained the principles of his "Norwegian self-acting cooking apparatus" as follows:—

The principle on which this cooking apparatus acts is, that of retaining the heat, and it consists of a heat retainer or isolating apparatus shaped somewhat like a refrigerator, and of one or more saucepans or other cooking vessels made to fit into it.



WITH ROUND SAUCEPANS.



WITH OBLONG SAUCEPANS.

In the ordinary way of cooking, the fire is necessarily kept up during the whole of the time required for completing the cooking process, the same result, however, is obtained in using this apparatus, by simply giving the food a start of a few minutes' boiling, the rest of the cooking being completed by itself in the heat-retainer away from the fire altogether.

To use the apparatus, put the food intended for cooking with the cold water or other cold fluid, as the case may be, into the saucepan, and place it on the fire. Make it boil, and when on the point of boiling, skim if required. This done, replace the lid of the saucepan firmly, and let it continue boiling for a few minutes. After the expiration of these few minutes, take the saucepan off the fire, and place it quickly into the isolating apparatus, cover it carefully with the cushion, and fasten the lid of the apparatus firmly down. In this state the cooking process will complete itself without fail. *By no means let the apparatus be opened during the time required for cooking the food.*

The length of time during which the different dishes should remain in the isolating apparatus, varies according to their nature. It may, however, be taken as a general rule that the same time is required to complete the cooking in the apparatus, as in the ordinary way on a slow fire.

The following dishes, prepared in Mr. Sörensen's apparatus, and placed in the boxes at the times specified, were then served up, and pronounced by the company to be excellently cooked and of excellent flavour:—

Beef Steak Pudding.	
Put on the fire at	10.35
Reached boiling at	10.50
Put into the apparatus at ..	11.0

Irish Stew. Fowl, with Rice. Potatoes.	
Put on the fire at	11.5
Reached boiling at	11.33
Put into the apparatus at ..	11.40

Leg of Mutton.	
Put on the fire at	9.30
Reached boiling at	10.3
Put into the apparatus at	10.10

The following are the advantages which Mr. Sörensen claims for his apparatus:—

1st. Economy in Fuel.—This varies according to the length of time required for cooking the different sorts of food. For those requiring, in the ordinary way, only one hour's cooking, the saving is about 40 per cent., two hours 60 per cent., three hours 65 per cent., six hours 70 per cent. In the case of gas being used, the saving would be still greater.

2nd. Economy of Labour.—As above stated, no sort of food requires to boil on the fire more than a few minutes (rich puddings might, however, require more boiling), and once in the isolating apparatus, the cooking will complete itself unattended to. The industrious housewife may, for instance, in the morning employ the same fire which has served for preparing the family breakfast, to cook the dinner; she may then extinguish it, and be at liberty to look after her other domestic duties, and even leave the house, without further care about the kitchen. No fear of burnt dishes, no fear of the food boiling over, no danger of fire, because there is none. When the hour of dinner is at hand, she opens the apparatus, and will infallibly find the dinner ready, as the cooking in the apparatus is completed with mechanical regularity. The food prepared in the apparatus will, however, never be overcooked and may remain in it three or four times as long as is required for completing the cooking, without getting cold or losing any of its nutritive qualities or good flavour. This is explained by the fact that the food is almost hermetically enclosed in the apparatus, and consequently not exposed to the evaporation which would occur in the ordinary way of cooking. The apparatus will keep the food sufficiently hot for from twelve to twenty hours, according to size.

3rd. Portability.—The self-acting cooking apparatus are made in all dimensions, and in many different forms; there are specimens with a single saucepan, holding from one gallon to three gallons, and others with two and three saucepans, containing together from one to five

gallons. Besides these, which are always on hand, others are made to order, containing three, four, or five saucepans, and still larger ones for one cooking vessel, containing from five to twenty gallons, specially adapted for use in barracks, hospitals, merchant vessels, ships of war, transport and emigrant ships, arsenals, poorhouses, prisons, asylums, and similar public establishments. The weight of the apparatus complete, varies from 18 to 50 lbs. All these apparatus can, in proportion to their dimensions, be carried about with great facility, without interfering with the cooking process. By means of a large apparatus, for instance, following on a cart a detachment of soldiers on the march, it is possible to provide them with a hot meal at any moment it might be found convenient (as may be proved by official reports from the officers of the Royal Guard, at Stockholm, in the possession of the patentee).

Again, fishermen, pilots, and others whose small vessels are not generally so constructed as to enable them to procure hot food while at sea, may easily do so, by taking out with them in the morning an apparatus prepared before their departure. It is, in short, a thing for the million, for rich and poor, for the domestic kitchen as well as for persons away from their homes; it cooks, and keeps food hot, just as well when carried about on a pack-saddle, on a cart, or in a fisherman's boat, as in a coal-pit or under the kitchen table.

4th. Quality of the Food Prepared.—A dish prepared with water or other liquid, and requiring three hours for cooking in the ordinary way on the fire, loses by evaporation from 20 to 25 per cent. in quantity. As part of this loss necessarily consists of nutritious substances, it is readily to be understood that the food cooked in the ordinary manner on the fire loses considerably in nutritious strength. By employing the self-acting apparatus nearly all evaporation is avoided, and consequently the loss of nutritious matter is almost imperceptible. It is for this reason that stewed dishes, soups, vegetables, fruits, coffee, and more or less all food prepared in this apparatus, will be found to have a most agreeable and aromatic taste.

5th. Simplicity of Use.—One of the greatest advantages of this invention is, no doubt, its simplicity and practical application. There is no complication of hot water or air pipes to retain the heat, no mechanical combination whatever for producing a high degree of heat by steam pressure; consequently there is no necessity for steam valves or other combinations which would render the use of the apparatus difficult and dangerous. Any person will, without difficulty, be able to use the apparatus to advantage after once having witnessed it in operation. No special arrangement is required in the kitchen for using the apparatus. Any fuel will do for starting the cooking.

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LECTURE.

Friday, March 27th, 1868.

Major-General The Right Hon. SIR HENRY STORKS, G.C.B., G.C.M.G., Comptroller-in-Chief, in the Chair.

AN ORGANIZATION FOR THE ARMY OF ENGLAND.

By Major J. Bevan-Edwards, R.E.

Mr. Chairman, Ladies, and Gentlemen,

The Council of this Institution has done me the honour to invite me to give a lecture on the subject of the "Reorganization of the Army." The subject has lately been much discussed in most classes of society, and by the press of this country. I feel great diffidence in undertaking so serious a task, but will endeavour to do so to the best of my ability.

About a year ago I gave much time and attention to the subject of the organization of the Army, and was induced to embody my thoughts in a pamphlet, solely intended for distribution amongst my military friends. I still adhere to the general principles on which my ideas were then formed, although to a certain extent the detail has been altered. I shall necessarily be obliged to give only a mere outline, as the time at my disposal will not permit of my otherwise treating so comprehensive a subject.

The present is a most opportune time for enquiring into the organization of our army. We cannot fail to perceive that there exists a general feeling of mistrust with regard to the efficiency of our military system, not in respect of the courage and discipline of our individual battalions, or of any of the component parts of our Army, but of its general want of fixed system and organization, which does not allow of our using to the greatest advantage, the armed forces now maintained by this country. I hope, in laying a scheme before you, to be able to point out that our armed forces may easily be placed in a condition to defend the country in case of invasion, and also to give the means for providing larger and more perfect expeditionary armies than we have hitherto despatched from our shores.

At the present time the empire has 620,000 men under arms, consisting of the regular army 200,000, the militia and yeomanry 130,000, the volunteers 170,000, and 120,000 regular native troops. It seems incredible that this country, with a force of 620,000 men under arms, can only put an army of 30,000 or 40,000 men into the field.

Let us enquire how we should be situated, and what we should do, if the country were threatened with invasion. We should call out our militia, yeomanry, and volunteers, but before they could become of any use they would have to receive an organization corresponding to that of a regular army. A mass of troops would, for the first time, be brought together, consisting of the regular army, pensioners, militia, yeomanry, and volunteers, without any proper proportion between the different arms of the service, and scarcely any field artillery. The present army would become the nucleus for the formation of *corps d'armée*, the infantry of each composed of a few battalions of the regular army, and a proportion of regiments of militia and volunteers. The remainder of the militia and volunteers would garrison our fortresses and coast batteries, and the militia and volunteer artillery, with the regular garrison artillery, would man the guns. The army in the field thus composed would consist of from 150,000 to 200,000 men, divided into corps of 20,000 or 30,000 men each. The infantry of this army would be indifferently armed, but in a tolerable state of discipline, and the cavalry, augmented by the yeomanry, would be in a fair proportion to it. The other brânches of the service would, however, be quite insufficient. At the lowest calculation the field artillery should number 450 or 600 guns, a force four or five times greater than we could command, and it would be almost without all the services that render an army capable of moving, such as the military trains and pontoon equipments. The officers of the staff, hastily got together, though admirably educated for their duties, would nevertheless be found inefficient from the absence of system and previous practice. Conceive the confusion and waste of strength that must ensue. Such an army might occupy a defensive position prepared beforehand, but if it were compelled to manœuvre in front of an invading enemy it would inevitably be broken up and destroyed, no amount of discipline in the few regular battalions, no individual gallantry and intelligence could save it from disaster—nothing could supply the want of organization. To make our bodies of armed men of any use for such a contingency, it is absolutely necessary that they should receive an organization in time of peace; and as it will not put the country to any additional annual expense, there appears no reason why they should not receive it. It would give confidence to the nation, and save it from those periodical invasion panics which have made us so ridiculous in the eyes of Europe.

In the second place, how are we prepared to send an expeditionary force on active service, such as that to Turkey in 1854? Under our present system we should have to despatch our soldiers (for I will not call it an army) from this country by battalions, regiments of cavalry, and batteries of artillery, thereby necessitating the occupation of a safe point near the enemy's frontier, in order first to

organize an Army out of the various component parts there collected, before we could be in a position to undertake any hostile operations.

It happened during the Russian war at Gallipoli, and afterwards at Varna. Supposing, however, that ample time was given, it is evident that no army formed under such circumstances could be really efficient. We should have a repetition of the great expenditure of the lives of our soldiers and the national money which occurred during the first part of the Crimean war.

We may take it for granted that, after providing for our colonies, our Army should be organized to resist invasion, and, so far at least as its numbers will permit, be able to despatch perfect expeditionary armies, thereby giving security to the country, and saving enormous expenditure in time of war.

In originating a scheme, I have endeavoured to keep the following conditions always before me. To cause no additional annual expenditure; to introduce only those changes which appear absolutely necessary; to leave existing interests undisturbed; to allow of our Army being reduced to the smallest possible limits in time of peace, consequently maintained at the smallest possible cost to the country; and to be sufficiently comprehensive to embrace all our various military bodies, enabling our Army in India to be more readily available for the general service of the Empire.

The scheme which I shall now lay before you deals only with the combatant branches, but I may venture to say that the new Comptroller-in-Chief will find it far easier to organize the non-combatant branches to meet its requirements, than to accomplish the task he now has before him, as at present he has no basis to work from.

With the present strength of our forces, we ought to be able to place in the field for the defence of the country, at the shortest possible notice, an army of 180,000 or 200,000 men, perfect and complete in all its various component parts. It is customary in these days to talk of armies of great numerical strength, but among the vast armies of the Continent, how seldom do we find in the field, at one point, a larger army than this. We have the men for such an army ready in this country, and they only require an organization in time of peace to make them available in time of war.

The following steps appear indispensable:—

1st. To concentrate the Army to a greater extent in the United Kingdom.

2nd. To divide it into *Corps d'armée* of equal strength, and distribute it with reference to them.

3rd. To organize the militia and yeomanry, so that they can readily join the regular *Corps d'armée.*

4th. To give to the field artillery an organization which will render it capable of rapid expansion.

5th. To form depôts for the establishment and instruction of a reserve of trained men for the different services.

1st. "To concentrate the Army to a greater extent in the United Kingdom," or, in other words, to make it more an imperial than a

colonial army. This is necessary for the purpose of establishing in the United Kingdom, a nucleus for the formation of a larger and more efficient regular Army than we have at present.

On the 1st January, 1868, the regular Army consisted of some 200,000 men, the combatant branches of which are divided into—

148 battalions of infantry.
31 regiments of cavalry.
31 brigades of artillery, viz.:—

6 brigades of	horse artillery.	
8	do.	field.
14	do.	garrison.
3	do.	of mixed field and garrison.

30 companies of engineers.
1 troop of engineers.
24 troops of military train.

Not to go too much into detail, let us only consider the distribution of the infantry, as the other services should generally be proportioned to it. There are 52 battalions of infantry on the Indian establishment, and 96 on the British establishment, the former paid for by India, and the latter from the revenues of this country. Of those on the British establishment there are 53 at home, and 43 in the colonies, so that with the regiments in India, 95 are on foreign service, and 53 on home service. But 7 of these latter are battalions of guards, who, as a general rule, do not take colonial service; so that there are only 46 at home to relieve 95 in the colonies. Thus, in time of peace, a soldier passes rather more than two years abroad to every year he does at home. If it is desirable to shorten the term of foreign service, it can be done with the present strength of our Army, by decreasing the number of battalions in our colonies; but if any particular colony requires more men, the strength of the battalions in that colony may be increased very considerably. The 95 battalions abroad are thus distributed: 52 in India, 11 in the Mediterranean, 18 in North America and the West Indies, and the remaining 14 at the Cape, New Zealand, Australia, Mauritius, and China.

There are two classes of colonies; the one, such as Australia, New Zealand, the Cape, and the North American is representative and self-governing. These colonies are virtually independent of the mother country, but we have a right to expect from them a certain amount of assistance, either in men or money, so long as they claim imperial protection. Where this is required on land, they must establish a powerful and well-organized militia to co-operate with our regular army. This case especially applies to the North American group, as these colonies are in immediate contact with a large and powerful nation, with whom they may some day be at war. Australia, New Zealand, and the Cape, not being placed in a similar position, do not require to maintain large forces of militia, they need only be prepared to protect themselves from naval attacks, or hostilities with their native tribes. In time of peace, the imperial garrisons are unnecessary in

these colonies, except where they are required to garrison one or two naval fortresses for imperial purposes. The very few battalions that are now stationed in them could be of little use in time of war without considerable reinforcements.

The other class of colony consists of Gibraltar, Malta, Aden, Bermuda, Mauritius, and Hong Kong. These are chiefly kept as naval arsenals and coaling stations. We are to a great extent, dependent upon them for the maintenance of our command of the seas, and consequently our naval supremacy, and for the safety of our mercantile marine, when we are at war with a powerful maritime nation. No expense or care should be spared in strengthening these colonies. They should be fortified and strongly garrisoned, and protected by every means in our power. If we reduced the garrisons of our representative colonies, we could bring to this country at least

6 battalions from North America,
3 „ the Cape,
3 „ New Zealand and Australia,

and I hope to show that by doing so, we should be in a better position than we are at present to provide for their defence in time of war. The number of regiments at home would then be 58, exclusive of the Guards, and there would be only 83 abroad, instead of 95 as at present.

The second step is to divide our regular army into *corps d'armée* of equal strength, and to distribute it with reference to them.

The Administrative units of an army vary according to different circumstances, and may be as in ours, a battalion of infantry, regiment of cavalry, or battery of artillery. The Tactical unit is much the same for all modern armies, it is called a *Corps d'armée*, composed of all arms of the service, infantry, cavalry, artillery, engineers, and trains in proper proportion to one another. If the Tactical units are not properly maintained in time of peace, it is impossible that an army can be effective in time of war. The Administrative units may remain as they are at present, but Tactical units must be formed, if we require our army for any other purpose than that of finding small garrisons for our colonies.

Some time since a committee of officers assembled to consider the "equipment and supply of an army in the field," but they were first obliged to decide the relative strength of the different branches of the army, or what should be in short, the Tactical unit. They came to the conclusion that it should be a *Corps d'armée* of about 16,000 men, composed as follows, viz.:—

12 battalions of infantry,
3 regiments of cavalry,
12 guns, horse artillery,
36 guns, field artillery,
3 companies of engineers,
1 troop of engineers,
8 troops of military train,

divided into two divisions, and each division into two brigades, the cavalry forming a separate brigade.

Now as this *corps d'armée* appears suitable to our army, we will take it for our Tactical unit. Our present regular army would form 12 corps of this strength; and 5 of these I propose to allot to India.

We will now consider how the different arms of the service are proportioned to attain this object.

First, the infantry. At present we have seven battalions of guards, and 141 battalions of line, in all 148. For the 12 corps, we require 144; 4 battalions of infantry might therefore be reduced.

Next the cavalry; we have 31 regiments. Cavalry (and also horse field artillery and military train) is only required for 11 *Corps d'armée*, because the corps which garrisoned the Mediterranean fortresses would not need any. The number of regiments therefore necessary for the 11 corps would be 33; two additional regiments therefore are required.

We now come to the horse artillery, which, like the cavalry, is only required for 11 corps. In considering the number of guns, it must here be stated, that the batteries of horse and field artillery in India will need twice as many guns as those on the British establishment, the reason for which will be explained when we come to the distribution of the different *corps d'armée;* so that we shall want in all for our 11 corps, about 192 guns; at present there are 180.

The proportion of guns of field artillery required for a corps is 36. Giving double this number to each of the 5 corps in India, we require for the 11 corps 576 field guns. We have, now, I believe, about 468.

The next service, viz., that of the Engineers, requires 3 companies and 1 troop for each *Corps d'armée;* the army in India employs native sappers, so the remaining 6 corps require 18 companies and 6 troops. These are for service with the *corps d'armée* in the field, and not for sieges, as, on account of the various duties which engineers are then called upon to perform, these numbers are not sufficient. At present we have 30 companies and 1 troop.

Lastly; the military train. The complement is 8 troops for a corps, so our 11 corps require 88. At present there are only 24, but 40 of these additional troops would be maintained by India for the 5 corps in that country. These troops according to our present system, are made up to a strength of about 140 men each when on service, giving in all about 1,100 men, scarcely one-third of that which is considered necessary in the Prussian army.

It appears then that the different arms of the Service required to form our Army into 12 corps are proportioned thus. The infantry have 4 more battalions than are necessary. Of cavalry, there are 20 regiments on the British establishment, and as we should only want 18, there would be two to spare. These would, however, be required by India. The horse artillery would require 12 additional guns, 6 of these being for the Indian establishment. The field artillery would have to be augmented by about 108 guns, 66 of these for the British establishment, and the remainder for India. The strength of the engineers should be increased; and the military train would have an addition of 64 troops, of which only 24 would be wanted for the British establishment, and the rest for India. Thus we should have a reduction, on the British establishment, of about 3,500 men, and an increase

of about 6,000 for the field artillery, military train, and engineers, leaving a balance of increase of 2,500. These men can be obtained without extra cost, by a corresponding reduction in the infantry battalions, which, when occasion requires, can be augmented with much greater facility than the other services can be created.

The 12 *corps d'armée* would be distributed as follows, viz.:—

5 in the United Kingdom,
1 in the Mediterranean,
1 in North America and the West Indies,
5 in India, with portions of a corps at the Cape, Mauritius, Ceylon, Singapore, and China.

The 5 corps in the United Kingdom, when made up to their full strength, would give an army of 80,000 men, ready at a very short notice for service in the field abroad; the home garrison being taken up by the militia.

The ordinary distribution of the 5 corps at home might be as follows:—

1st Corps, of whom the guards would form a considerable portion, in and around London.

2nd Corps in the south-eastern district, at Dover, Shorncliffe, Chatham, &c.

3rd Corps in the south-western district, at Portsmouth, Plymouth, Winchester, and including the permanent barracks at Aldershot.

4th Corps, a division in the western district, and a division in the northern.

5th Corps in Ireland.

The garrisons of Malta and Gibraltar would require the strength of a corps, and would have a division and head-quarters, say at Malta, the other division being at Gibraltar. The corps in North America and the West Indies should be thus distributed, viz., a division in Canada, a brigade in Nova Scotia and New Brunswick, and a brigade in the West Indies and Bermuda, to which the native West Indian regiments should be attached.

With reference to the 5 corps in India and the other Oriental colonies; the following are some of the chief reasons for including all these latter with India.

1st. To suit the general scheme for this organization.

2nd. In respect to the garrison of colonies within the tropics, experience shows that wherever European soldiers are so employed, there should be with them at least an equal number of native troops to perform those duties which entail such heavy losses upon Europeans, and which natives can discharge without detriment. If this had always been done, we should not have so lately witnessed the great loss sustained by a British regiment at Hong Kong. I was in China when it took place, and I know that the duties they were called upon to perform could have been done more efficiently by a regiment of native troops, and at a great saving of expense to the country. Native troops should then be employed at all stations within the tropics, and India is the country from which they might most readily

be obtained. They should only be to save the European, not to supersede him.

3rd. In the event of England being engaged in a war with a powerful maritime nation, it would be necessary to place considerable garrisons in Hong Kong, Singapore, and Mauritius, in order to guard our docks, naval depôts, and coaling stations, and to enable our fleets to keep the sea and protect our commerce. The reinforcements for these garrisons should come from India, which would be the base for their defence, England being too far distant, and it may be presumed, having already quite enough on her hands.

4th. The expeditionary corps required from time to time for our wars with China, Japan, or, as at the present time, with Abyssinia, would be more readily supplied from India than from this country.

These considerations should be taken into account in devising a scheme for the organization of our Army in India. The five corps in India should be incorporated with the Native Indian Army, and their strength would then be doubled by adding to them an equal proportion of natives. Thus each corps would consist of

24	12 Battalions of European Infantry.			
	12	do.	Native	do.
6	3 Regiments of European Cavalry.			
	3	do.	Native	do.
24	Guns of Horse Artillery.			
72	do.	Field	do.	
6	Companies of Native Sappers.			
8	Troops of Military Train (double strength).			

Each corps would be divided into two divisions, each division into two brigades, the Cavalry forming a brigade. A considerable portion of the Native Indian Army might be absorbed in this way, especially if each Native battalion were made up to a strength of 1,000 men. To give a proper proportion of artillery, there should be eight guns to a battery, and the men required to make up the necessary numbers above the European strength, might be natives: this, to a certain extent, was the case formerly, as the drivers of a battery of artillery were natives. Such an organization as this would have been found most advantageous during the present Abyssinian campaign. When it was decided on that an expedition should be sent, and as soon as its strength was determined, it would only have been necessary to have ordered a division of the Army, near the port of embarkation, to prepare for active service, and every one connected with it would have known what was required of him; the nucleus for the military train would have existed, and might have been temporarily reinforced from other divisions without having to create, in time of emergency, the land transport corps, of which we have heard so much lately. Under this head alone, the saving of expense in the Abyssinian Expedition would have been sufficient to cover the cost of maintaining the nucleus of military train for the corps in India for a considerable time. This body of military train would have enabled the expedition to have proceeded on its march with only just sufficient delay to

make the roads practicable. Had the expedition been formed of one of these divisions of the Indian Army, it would have consisted of a body of men accustomed to work together, instead as at present, of detachments from so many different corps.

The present distribution of the army in India would readily accord with that of the five *corps d'armée*, but one of them would have to find half a brigade for China, half a brigade for Ceylon and Singapore, and a brigade between the Cape and the Mauritius.

At the present moment, there are 52 European regiments in India, so that with two in China, two in Ceylon and the Straits Settlements, two in the Mauritius, and two at the Cape, we should have 60 battalions, the number required for five *corps d'armée*. With this organization, suppose at any time we want an army for service, such for instance as that which was sent to assist Sir Ralph Abercrombie, a *corps d'armée* of 32,000 men could be dispatched on the shortest possible notice, perfect and complete in all its different requirements; whereas, under the present system, a great length of time would be required to get such a body of men ready to take the field, and with a certainty of the expedition breaking down, because it would be necessary to create for it in time of war, an organization that should have existed to a great extent, in time of peace. This then is the secret of our numerous failures in sending expeditions on active service.

If it is difficult to extend the corps organization to that portion of our army in the colonies; the army in the United Kingdom and in India should at all events be divided into tactical units or *corps d'armée*, then the garrisons of the colonies would remain as at present, with the exception of the withdrawal of 12 battalions from the representative colonies; the reliefs of the army being carried out as heretofore. I do not anticipate that this scheme "for the organization of our regular Army" could be carried out without some difficulties to be overcome, but the want of a general plan is so urgent as quite to over-balance them, and the necessity for it will be more apparent when we consider the next proposition—which is the most important for the defence of our country, viz.:—

To organize the Militia and Yeomanry so that they can readily join the five regular *corps d'armée* in the United Kingdom. This is rendered necessary, because, with the present organization, the Militia and Yeomanry cannot act efficiently with the regular Army. Every battalion of Militia and regiment of Yeomanry should belong to some *corps d'armée* of the regular Army, and occasionally be trained with it in time of peace. The plan I propose, will enable these five *corps d'armée* to be at once doubled and raised to an effective strength of 160,000 men.

The Militia Infantry now consists of 135 battalions; this number of battalions is more than is required for the actual garrison duties of the United Kingdom; after reserving a sufficiency for these duties, therefore, let us give the remainder an organization that will enable them at once to join the regular Army. On account of the increased means of communication by railway and steam, there is no longer that necessity, which formerly existed, for scattering the head-quarters of the regiments so much. I therefore propose to take the 135 battalions, and, without

increasing the total number of men, to make 60 regiments, each of three battalions; the first battalion to join the regular Army; the second to perform garrison duties, and the third, as a depôt battalion, to form a reserve for the instruction of recruits before they join the first or second battalions, and also to enrol on their strength large bodies of men as reserves for every service, who would be available when required. This could be carried out in the following manner. Take the men most willing to serve and undergo more efficient training, and put them into the first battalions, and let each of these battalions be 1,000 strong—in all 60,000 men. In the second battalions place those men who, from various causes, are unable to give up so much of their time for training; and if each of these battalions consisted of 600 men, they would be sufficient for the ordinary garrison duties. These second battalions would then require 36,000 men; but if the pensioners, 15,000 strong, be incorporated with them, then they will only require 21,000 men, or 81,000 for the first and second battalions.

In the third or depôt battalions, I would place the twelve years' service men, who now form the new "Army of Reserve," and also the "Militia Reserve," because from the former we might obtain the drill instructors which we require for our recruits. They should also have men enough to fill up the ranks of the regular Army in time of probable invasion. For this purpose, inducements should be held out to men to enrol themselves on their strength and go through a course of instruction; and these men should be enlisted on the understanding that they were to serve in the regular Army in the event of invasion. All recruits, before joining the first and second battalions should receive their training in these depôt battalions, and be thus fitted at once to take their places in their regiment. The first battalions should be broken up as little as possible, in time of war, by men volunteering for service into the regular Army, as that is the time when they are required to be most efficient.

With regard to the Yeomanry, I would adopt a somewhat similar system. At present it consists of 48 corps, numbering about 14,000 men. The present organization of these corps and their limited periods of training will not allow of their acting efficiently with the regular Army. I propose that it should consist of 15 corps, each corps of 2 regiments. Like the first battalions of militia, the first regiments of each corps might be composed of men to serve with the 5 regular *corps d'armée*, and give up more time to their annual training. The second regiments should consist of men who could only give the limited time for training which they do at present, but they would be available for garrison duties if called upon. The first regiments should be about 650 strong, and the second 300; the former would give the means of doubling the cavalry of the 5 *corps d'armée* when required, 3 regiments to each corps.

By effecting this change in the organization of our militia and yeomanry, we could find men at any moment to double the strength of the regular Army in the United Kingdom; but it would be necessary for the efficiency of the whole, that they should sometimes join the regular *corps d'armée* in time of peace. For this object camps should

be occasionally formed for the instruction of the different corps, and the militia and yeomanry should join for a short time their *corps d'armée*, and be attached to the brigades of infantry and cavalry to which they belong, raising the corps almost to its strength to resist invasion. Thus the *corps d'armée* in the London district might be encamped on some convenient site south of the Thames, and be joined by its militia and yeomanry, whilst that in the south-western district would encamp on some of the large heaths or commons in Hampshire, and the corps in the south-eastern district, in West Kent or Sussex. Each of these *corps d'armée* would represent at its full war strength, 32,000 men, and the three might march to a central camp for a short period, forming an army representing 96,000 men, and afford the generals and staff some practice in moving large bodies of troops. The *corps d'armée* in the other districts might occasionally encamp in smaller bodies—by divisions, or brigades at least, with the yeomanry and militia attached to them.

Such a system as this would thoroughly test the training of the whole, and enable the 5 *corps d'armée* when required, to assemble for active service without the least delay or confusion, whilst the Officers of the staff would know what was required to complete and render them fit to take the field. They would form an army, in short, as well organized as either of the Prussian armies which invaded Bohemia in 1866, provided the non-combatant branches corresponded to its wants.

The Militia artillery should remain as at present, as its services would be invaluable in manning the guns of our coast batteries and fortifications, in conjunction with the regular garrison and Volunteer artillery.

The next step is to give the field artillery such an organization as to render it capable of expansion. Such a force of infantry and cavalry as we have described requires a proper proportion of field artillery. We want for the five *corps d'armée* 120 guns of horse artillery, and 360 guns of field artillery. According to the present system, this would be 80 batteries of 6 guns each—a great many more than we now have. To be able to obtain this number of guns as quickly as possible, we should have more batteries, with fewer guns in each, as it is far easier to increase the number of guns in a battery than to create new batteries in a time of emergency; and instead of having 80 batteries of 6 guns in time of peace, it would be better to have 60 batteries of 4 guns to be increased to 8 guns in time of war. This organization would allow of our field artillery being doubled in the shortest possible time. I would apply this system to the whole of our field artillery, as it would also be necessary for India.

A brigade of artillery should supply the wants of a *corps d'armée*, and consist, in time of peace, of 3 troops of horse artillery, and 9 field batteries of 4 guns each. In time of war these batteries, increased to 8 guns, would give the number required for a *corps d'armée* at its war strength, viz., 24 guns horse artillery, and 72 guns field artillery. In time of peace, when these brigades joined their respective *corps d'armée* in camp, and the batteries were increased to 8 guns, they could make use of the horses from the second line of waggons for

the extra guns, and leave the waggons at the different stations they came from; or, if any difficulty was experienced in this, they need only be increased by 2 guns.

We have now come to the last step, which is to form depôts for establishing and training a reserve, so as to supply men for the different services. The third battalions of militia would furnish the men for our battalions of infantry; those for the other branches could be obtained in the following manner:—Attach to each of the 60 third or depôt battalions of militia, a depôt battery for the field artillery, a depôt company of engineers, and a depôt troop of military train. They must be composed of men who will serve with the corresponding regular branches of the Army in time of probable invasion, and during a portion of their annual training. Each depôt battery of artillery should consist of about 120 men (a proportion of whom should be drivers), and be trained by competent artillery instructors, and commanded by an Officer who has served in the regular Army. If the twelve years' service men from the artillery were enrolled in these batteries, there would be no lack of instructors. In the same way I would establish a depôt company of engineers. If each company consisted of from 30 to 40 men, it would be sufficient, they could also be instructed by the twelve years' service men, like the artillery; an Officer who had served in the regular engineers might be appointed to command, or as an inspector to a certain number of companies. Depôt troops of military train might also be established, consisting of men who, from their knowledge of horses, would make drivers, and the number of men in them might be unlimited. The five regular *corps d'armée* could thus be raised immediately to 80,000 men; and by means of the organization proposed for the militia and yeomanry, they could at once be doubled, and form a perfect and complete army of 160,000 men, around which all the armed force of the kingdom might rally to resist invasion.

Now, if such an organization as this existed, on the order being given for any *corps d'armée* to be put on the war footing, it could be done without delay or confusion, and be ready to take the field in the shortest possible time. Every Officer and soldier would serve in it with the greatest confidence. As it is at present, we cannot feel otherwise than that we have an Army which might fail in the hour of need through want of organization. Contrast one of these *corps d'armée* with a Prussian corps. Our British corps would consist, in round numbers, of 24,000 infantry, 3,600 cavalry, 96 guns, 600 engineers, 1,100 military train, whilst the Prussian consists of 25,600 infantry, 3,500 cavalry, 96 guns, 618 engineers, 3,700 train. They are almost identical, with the exception, however, of the military train, which is 3½ times stronger in the Prussian corps. We know how admirably organized the Prussian *corps d'armée* were found to be, it is, therefore, no disparagement to ours that they should be like them.

This scheme would allow our army to be reduced to the lowest possible limits in time of peace, as it would only be necessary to have a sufficiency of trained men in reserve with the depôt battalions of militia to be able at once to fill up the different services to their

full strength to resist invasion. Our battalions might not be so perfect as they now are, but the whole Army would be much more efficient.

I remarked at the beginning of my lecture that this organization could be carried out without incurring extra annual cost. A primary expense would be caused, however, by having to construct barracks at the head-quarters of each of the sixty regiments of militia. There would also be a further expense entailed upon the country in acquiring the right to encamp troops on convenient heaths and commons, and for the purchase of sites for that object. As it is necessary to increase some of the branches of the service, such as the field artillery and military trains, to enable them readily to meet the requirements of the army in time of war, it could be done without expense by slightly reducing the strength of the battalions of infantry. It has been stated before, that infantry is inefficient without the other services, and when required can be more readily increased.

Any one who considers the present organization of our army cannot but feel surprise and astonishment that the country should for so long a time have submitted to an enormous extra expenditure in time of war for want of organization and a proper proportion between the services in time of peace. We know how the army suffered in the sieges during the Peninsular war for want of a sufficient engineer corps and siege train. If the infantry had been 3,000 or 4,000 less, and the engineers and artillery increased by that number of trained men, what a loss of life would have been saved! We need only go back to the army in the Crimea, with its inadequate force of engineers, and without any military train, to see how differently it would have been situated had only 1,500 of the infantry been trained sappers, and 2,000 employed as military train. It was well known before the Crimea that railroads would play an important part in future wars, and consequently the engineers of our Army should have been trained in their construction and use. The 1,500 additional sappers might have been used as infantry if required, but employed in their legitimate occupation, they would have saved the great expense of the army works corps, and have made a tramway or light railway from Balaclava almost to the front before the Army began to die from starvation and exposure. What would not a military train 2,000 strong have done towards saving our army from destruction? Under these circumstances I think we may come to the conclusion that it would have been better to have had 3,500 less infantry in the Crimea, and to have employed this body of men in the above-mentioned manner, as they would have saved the remainder from destruction. We are now very little better off than we were during the Crimean war; we have a larger force of field artillery, and a small body of military train, but if we were to put 30,000 men into the field to-morrow, we could not undertake any operations a few marches away from our ships.

In considering the subject of the volunteers, although at different times there has been a large force of them in England, we find the present movement is quite one of recent date. It is nothing more than

what should always exist, as every able-bodied man should be trained in the use of the national weapon, whether it be a sword, a bow and arrow, or, as in the present day, a rifle. In these times, however, it is also necessary that they should be able to act in bodies, and thus the battalion and company drill is required. The present volunteer movement is essentially battalion, and if they will train themselves in the use of the rifle and learn their battalion drill, that is all that we should expect from them. If we try to give them the organization of a regular Army, we shall be going too far, as they could not be really effective without all the other branches of the Service, such as field artillery, cavalry, and military train, besides the non-combatant branches. For 170,000 volunteers, the number of field guns required would be at least 500, and without any disparagement to the volunteers, I think it quite impossible that they could produce such a force of field artillery fit to take the field. If the movement continues with its battalion organization, it will be found of the greatest use to the country in case of emergency; but if we attempt to give it an Army organization, it would tend to give the country a feeling of false security.

It is thus that I would utilise our volunteers. When the *corps d'armée* were called out to oppose an invasion, I would attach to each brigade of infantry two battalions of volunteers. If the battalions were 600 strong, which is a fair average, it would absorb 24,000 at once; but if a little time were given, the infantry brigade might be divided and take 48,000 volunteers or more. Very large garrisons would be required for our dockyards, and here our volunteers would be of the greatest service; Portsmouth could employ at least 40,000 or 50,000, Chatham 30,000, Dover 20,000, Plymouth 40,000, Pembroke 30,000; in round numbers for these places alone, 170,000, and there is also the north of England, Scotland, and Ireland. The garrisoning of these important places would give work enough for our volunteers, and by liberating our Army of 160,000 or 200,000 men for service in the field, they would enable it to hold its own against any probable invading force. Behind the fortifications of our dockyards the volunteers would quickly be formed into most efficient and formidable armies, who could attack the rear or threaten the communications of an enemy.

If the militia in our North American colonies was organized on the plan proposed for that of the United Kingdom; by sending the 5 *corps d'armée* from this country to join it, we could at once place an organized Army of 160,000 men in the field for their defence; and any of the militia battalions, in addition to those required to join our regular Army, would be available to garrison the fortresses. Thus it will be seen, that by the withdrawal of a few of our regular battalions from these colonies in time of peace, we should be in a much better position to defend them when called upon to do so.

With regard to the depôts for the instruction of recruits for our Army, I would remove the present depôt battalions, and distribute them among the barracks for the militia. They would then become schools for the instruction of the recruits for all the different services

of our Army. They would be the centres at which every able-bodied man of the nation could be drilled, if necessary, and also become the head-quarters for the recruiting.

Before concluding this lecture there are some suggestions which I should wish to make.

During the Russian war, a great proportion of the men of the militia passed from its ranks into the regular Army, and several whole battalions volunteered their services for the Crimea. Will not any war in which we are engaged be popular with the people of this country? If it were not, could it be carried on? Cannot this enthusiasm be made use of? Why should not our militia, or rather let us call them "Army of Reserve," be in a great measure a volunteer Army, for general service during war only? Then the first battalions of militia could be composed of men whose services would be at the disposal of the country, for employment abroad during time of war. Would not a comparatively small inducement held out to them, secure their services, and also those of the men we require for the field artillery, engineers, and military train? It should be clearly understood that they would be only liable to serve during the continuance of hostilities, and so soon as peace were made, they would be allowed to return to civil life. Then we should be able to despatch from our shores an army of 160,000 men, which would only require an augmentation to the cavalry, to make it perfect.

As to the means of obtaining recruits to fill up the casualties of war. Why should we enlist men in time of war for 12 years' service? Why not enlist them for service during the war only? Many a man would become a soldier for the excitement of a campaign who is now deterred from enlisting because he must do so for 10 or 12 years. A considerable increase to the field allowance would offer a great inducement to men to enlist for a campaign.

It is possible that this country may some day be obliged to put 300,000 or 400,000 men into the field; how could it do so effectively unless we organize our present forces in such a way as to be capable of expansion? Whatever objections may be made to this scheme (and it is quite impossible to devise one against which many may not be raised), there remain these facts, *that with the forces now at our disposal, and without any increase in our present annual expenditure, we should be able to turn out for the defence of the country, in the shortest possible time, a thoroughly organized army of* 160,000 *or* 200,000 *men, and also have the means of despatching from our shores a perfect expeditionary corps of* 80,000 *men.*

Do we not require such an organization for our army? If so, let us not wait until we have been taught the necessity for it by a great national disaster.

Evening Meeting.

Monday, April 27th, 1868.

Major-General The HON. JAMES LINDSAY, Inspector-General of Reserve Forces, in the Chair.

NAMES OF MEMBERS who joined the Institution between the 20th and 27th April, 1868.

ANNUAL.

Mainwaring, Alfred R., Lieut. R.A. 1*l*.
Moffatt, Boland G., Lt. 8th, or King's. 1*l*.

ARMY ORGANIZATION.

OUR INFANTRY FORCES AND INFANTRY RESERVES.

By Major Arthur Leahy, R.E.

The Chairman.—Major Leahy, whom I have now the pleasure of introducing to you, will read us a paper this evening upon "Army Organization, our Infantry Forces and Infantry Reserves." It will be in the recollection of many of the gentlemen now present, that, a short time ago, Major Edwards read a paper in this theatre entitled "An Organization for the Army of England." The subject of Army Organization is now engaging great public attention. It is perfectly evident that within the last year, public opinion has been formed to this effect, that, with our considerable force of Militia and Volunteers, it is now high time that the various forces which compose our Army and its Reserves, should undergo such an organization, as will, in the event of a war, adapt them to the service of the country, not only at home but abroad. Without carrying the scheme so far as either Major Edwards or Major Leahy propose to do, for there is still considerable difficulty in this country in bringing our Reserve Forces, in the shape of the Militia and Volunteers, into a more active organization for the purpose of instruction, some assurance must be given to the country, that these forces are being organized, and brought together from time to time for the purpose of acting as an Army, instead of each force remaining in that isolated state in which hitherto it has been for years.

Therefore, whether the larger plan which these two gallant Officers bring forward can be carried out later or not, there is no doubt that there is a call for an organization of some kind or other, and unless this be brought forward in the course of another year, the public will be greatly disappointed. The subject has been noticed in the House of Commons; it has been engaging public attention; and sooner or later, through the agency and help of gallant Officers like Majors Edwards and Leahy, this desirable organization of the Army will doubtless be carried out.

Major LEAHY: I am induced to lay before the meeting the propositions in the paper which I am about to have the honour to read, in the hope that I shall thereby contribute to the ventilation of the important subject which was recently brought under the notice of the Institution by Major Edwards, in a lecture entitled, "An Organization for the Army of England," and I feel sure that any suggestions which may encourage discussion, or help towards bringing about a practical solution of the difficulties with which the subject of Army Organization is surrounded, will be indulgently received by the meeting.

I do not propose to enter into the circumstances, so fully set forth in Major Edwards' paper, under which an earnest consideration of the question is called for at the present time, but it appears to be necessary, for the proper understanding of what I am about to say, that I should recite certain general propositions which were enunciated at the lecture, and in which I venture to assume we shall all concur.

These propositions are—

1. That it is the general opinion of the public that there are defects in our military organization which require to be remedied in order to admit of the armed Forces, maintained by the country, being used to the best advantage.

2. That these changes are more especially necessary in respect of the Forces for national defence, and that if the necessary reforms be carried out, we ought to be in a position to place in the field, at very short notice, an army of about 200,000 men for home defence, and by so doing, to save the nation from periodical invasion panics.

3. That if circumstances should arise which render necessary the despatch from our shores of an expeditionary force, we should be in a position to equip and send out a limited expeditionary corps without delay, confusion, or extravagant expenditure.

4. That our self-governing colonies, more especially the dominion of Canada, are bound to train local militia, or other forces, to co-operate with our regular Army in the event of the occurrence of wars requiring that the several territories should be protected from aggression.

5. That it is desirable to effect any necessary changes without increased annual expenditure, without injuriously affecting existing interests, and on a system which will admit of a reduction of the standing Army to a minimum establishment in time of peace.

These, I apprehend, comprise the chief points of the problem which we would desire to solve, and I am impressed with the idea that if

the subject be dealt with on a comprehensive basis, and with a determination that in carrying out any necessary reforms, objections on matters of detail shall not be allowed to interfere with the execution of such general scheme as may be eventually approved, the solution will not prove so difficult as may be supposed.

On one point only do I desire to express a strong doubt, that is whether any scheme to carry out the project for keeping a larger number of men in immediate readiness for active service can be carried into effect without an immediate increase of annual expenditure. I do not think, however, that the public would object to that expenditure, provided it was solely incurred on the "non-commissioned officers and rank and file" of the additional forces, and not absorbed in additional staff or establishments.

The extra expenditure would be tolerated with less grudging if the project provided for an eventual reduction of the non-effective charges which now absorb over two millions of the fifteen and a half voted in the Army Estimates.

The subject of Army Organization has, it appears to me, to be considered under the following heads:—

A. Political. Under this head may be considered—

The constitution and government of the military forces and establishments. The persons liable to military service, and the conditions of such service. The general control or checks to which the executive, charged with the management or command of the Forces, and with the expenditure of public moneys set apart for military purposes, shall be liable.

B. The organization and training of the combatant forces, and the regulations under which they shall be called out. The determination of the numbers to be annually embodied, and whether for permanent service or for a certain number of drills or days' training.

C. The administrative organization, viz., that by which the supply of all things necessary for the efficiency of the combatant troops is regulated, and the accessory arrangements, made with the object of increasing their defensive or offensive powers.

Under each of these divisions several important questions may be raised on which lengthened discussions could be taken; but although necessary for purposes of explanation to refer to points which do not come under that head, it is not proposed to invite *discussion* on questions other than those necessary for the consideration of the second division, viz., the numbers, training, and organization of the combatant troops.

Even that appears to me too large a subject to be exhaustively dealt with in a single paper, and I only propose to enter into the details of that branch of it which relates to the organization of the infantry forces on the British establishment, and our home reserves.

On the numbers, organization, and distribution of the infantry must depend the proportion and organization of the auxiliary arms of

the Service, viz., cavalry, artillery, engineers, and of that portion of the train which has a place on the field of battle for the transport of ammunition, wounded, &c.

I will, in the first place, call your attention to the composition of the Imperial Forces and to the figures, which I believe to represent tolerably correctly, the numbers of the regular troops and of the reserve and auxiliary Forces which it is within the power of the Crown to call out for defence of this realm, or of the possessions subject to Her Majesty.

The establishments which at the present time come under the supervision of the Governments of this country and of the Governments of India, Canada, and the colonies in Australia, the Cape, &c., are—

I. *The Regular Army.*

The existence of this Army is dependent on the annual votes of Parliament, and the total numbers voted for the year 1868-9, including the proportion of British regiments set apart for service in India, and paid out of Indian revenues, are as follows:—

REGULAR ARMY, 1868-9.

	British Establishments.	Indian Establishments.	Total.
Infantry	87,898	45,962	133,860
Colonial Corps	7,770	..	7,770
	95,668		141,630
Artillery	20,712	12,855	33,567
Cavalry	12,189	5,410	17,599
Engineers	4,726	339	5,065
Train	1,798	..	1,798
	135,093	64,566	199,659
Miscellaneous Corps and Establishments	13,698	..	13,698
Totals	148,791	64,566	213,357

The whole of the foregoing numbers are embodied for permanent service.

The number of horses on the British Establishment is 13,000.

In reference to the regular Forces, I do not propose any material alteration in the total numbers of the Officers, non-commissioned officers, and men of the infantry regiments (I have not gone into the details of the other branches of the Service). What I do propose is, that the infantry shall be so organised that the regiment shall be the unit for purposes of recruiting, for training soldiers for colonial or Indian service, and for training reserves. Each regiment should therefore consist of two or more battalions, one battalion being on colonial

service, and made up to its quota by periodical drafts of volunteers from the home battalion. To the home battalions should be attached a proportion of the army reserve forces sufficient to make up both battalions to the war establishment.

The details will be found in the tables, which have been printed as appendices to this paper.

I propose that the position of Officers commanding regiments and battalions shall be improved; the former so as to be equal to that of regimental Colonels of the Royal Artillery, and they shall be made responsible for the recruiting of their regiments, and be entrusted, subject to proper checks, with the management of the reserves which are held in readiness to fill up the ranks of their corps in the event of the occurrence of war or other contingency requiring it to be placed on a service footing.

Subject to approved regulations, they would determine the time, and place at which each reserve soldier should undergo his annual training, and probably regulate the retaining fee accordingly.

They would, in fact, be generally responsible, not only for the drill and discipline, but also for the establishment of the regiments.

The unit for purposes of administrative organization, would be a division (or, in time of peace, a military district), consisting of two or more brigades.

The duties of inspection and supervision of training to devolve on the General Officers commanding districts, and the Brigadiers serving under their orders.

The supervision of all enrolled Forces, whether reserves, militia, yeomanry, or volunteers, to be entrusted, ex-officio, to these officers.

In camps, when the militia and volunteers would be brigaded with the Line, the officers commanding regiments would become the acting brigadiers, assisted by temporary staff, selected probably from officers who had passed the Staff College. Their fitness for active commands would then be tested, and the command of a regiment would be sought as the last stepping-stone to a General's command.

II. *The Local Army in British India.*

The numbers and composition of these forces, which are paid out of Indian revenue, are decided by the Secretary of State for India in Council, subject to the sanction of Parliament.

According to the official book, entitled "Army of Great Britain, "1867-8," published by the Topographical and Statistical Department, the present numbers are as follows:—

Infantry	104,070
Artillery	2,097
Cavalry	23,585
Engineers	3,248
Miscellaneous	4,020
Total	137,020

These forces are permanently embodied.

III. *The Reserve Forces.*

The establishment of these forces was fixed by the Army and Militia Reserve Acts of 1867, and they consist of three classes.

Class I. Men who have served or are serving with the regular forces, and whose first service has not exceeded the first term of enlistment	20,000
These men are to be liable to permanent service in or out of the United Kingdom.	
Class II. Pensioner reserve..	30,000
These men are liable to service in the United Kingdom only.	
Class III. Militia reserve	30,000
To consist of volunteers from the Militia, and to be liable to general service.	
Total	80,000

These establishments have not yet been completed, nor does there appear to be any immediate prospect of filling up class I. The regulations in respect of class III. are not yet published.

The modifications that I would propose with the object of increasing the numbers and efficiency of the reserves are—

1. To attach to each regiment the proportion of reserves required to fill up its ranks in time of war. This will absorb classes I. and III. (say 50,000 men in all).

To entrust to the professional officers, now kept up for the purpose of commanding these men, the duty of training them, and not to depute that duty to militia officers.

2. To shorten, if necessary, the period at which a soldier may pass into the reserve, especially in those cases where the men have learned an industrial employment in which they would be likely to lose proficiency by a long period of embodied service. This ought to increase the number of enlistments and diminish desertion.

3. To form special corps for garrison duties, composed of men of good character who have served with their regiments for a *full period of home and colonial* service, and who have been allowed to re-engage for further duty.

These corps shall be formed on the model of the Coast Brigade Royal Artillery, and to be employed in the United Kingdom and in the Mediterranean, St. Helena, &c. The men to undertake certain garrison and other duties which now take men away from their regimental duties and interfere with the training of young soldiers; and to be employed, when possible, on the public works, or in other duty for which extra pay is granted. Clerks and messengers in military offices, servants for staff officers, &c., should, when not pensioners, be taken from the men of these corps.

They should have special privileges in respect of marriage, exemption from drill, &c.

A small proportion of officers only need be permanently employed, and the greater proportion of these might be taken from the ranks. In time of war the complement of officers could be completed from the half-pay list.

These corps would form the "cadre" to which the disembodied pensioner force of 30,000 men would be attached when permanently enrolled, or when mustered for inspection, and they would be very useful for the defence of fortresses; more especially when the war garrison would consist chiefly of volunteers.

The pensioners from the cavalry, artillery, and engineers should be attached to their respective corps.

It has been stated before the Royal Commission on Recruiting (Question 4,299) that the large proportion of re-enlistments in the Royal Artillery is in no small degree influenced by the inducement of service in the Coast Brigade; and it is conceived that the formation of a similar corps for line soldiers would have the effect of making the service more attractive.

IV. *The Auxiliary Forces*

Comprise the militia, yeomanry, volunteers, and trained bands.

(*a.*) *The Militia.*—The present establishment for the three kingdoms is 120,000, with power upon invasion, or imminent danger thereof, to raise it to 180,000 men, the original and additional numbers being as under:—

For England (by 15 and 16 Vic., c. 50)	80,000 40,000
For Scotland (by 17 and 18 Vic., c. 106; 23 and 24 Vic., c. 94)	10,000 5,000
For Ireland (by 17 and 18 Vic., c. 107; 23 and 24 Vic., c. 94)	30,000 15,000

And, as to *England* at least, the total number may be raised by ballot.

In the estimates of 1868-69, provision is made for the embodied pay of 5066 permanent Staff, at a cost of £205,000, and for the pay during training, of a proportion of the 128,971 militia officers, non-commissioned officers, and men, the sum taken for training is £194,000, being somewhat less than the cost of the permanent Staff.

This is a fact which I would ask you to bear in mind. It is a question whether the numbers and cost of this staff may not be reduced.

The militia has existed as a county establishment for over three centuries, and service in the force is compulsory (with certain exemptions) for men between the ages of 18 and 30, to be selected by ballot from lists prepared by the Lord Lieutenant; any man drawn has, however, a right to provide a substitute, and as there is now no difficulty in obtaining the requisite number of volunteers for the authorized bounty of £6 (spread over five years), the ballot is annually suspended by Act of Parliament.

The number of militia called out for training in 1866 was about 71,000, of these about 4,400 were absent without leave.

Several letters have recently appeared in the papers urging the necessity for paying more attention to the training of the militia, and especially advocating greater care in the selection of officers, who, according to the intention of the force, ought to be county gentlemen, with local interests common with their corps.

It is represented that in consequence of the system of appointment and the absence of test of personal fitness for command, the officers are not up to the mark. If this be so, the defect should be remedied, but there would not appear to be any reason for disturbing the constitution of this, our earliest, military force.

(*b*). *Yeomanry Cavalry.*—This volunteer force takes precedence immediately after the militia, and before other volunteer corps.

In case of rebellion, or invasion, or on appearance of an enemy on the coast, this force may be assembled for active service.

The yeomanry consist of 48 corps, comprising 264 troops; the total number as shown in the estimates 1868–9 is 16,185. It is suggested whether "appearance of an enemy on the coast" is not in these days of steam an expression now out of date, and one which should be revised.

(*c*). *The Volunteers.*—No limit is placed on the Crown as to the number of volunteers which may be enrolled for service.

The volunteers can, in case of invasion, be ordered to march to any point within Great Britain.

The establishments and efficients of the volunteer corps which have been formed under authority are as follows:—

STRENGTH OF THE VOLUNTEER FORCE, 1867.

Arm.	Maximum Establishment.	Enrolled.	Efficient.	Extra Efficient.
Light Horse	935	699	507	458
Artillery	40,666	35,508	30,611	..
Engineer............	6,580	5,511	4,715	4,301
Mounted Rifle	575	394	272	114
Rifle	167,056	145,752	119,111	85,715
Total	215,812	187,864	155,216	90,588

(*d*). *Trained Bands.*—It would appear that the 46 Geo. III., c. 90, though not in operation, is still in force, and could (it is presumed) be put in operation in England (excluding Wales) by Order in Council and proclamation. Under it the Crown can enrol 200,000 men, and upon invasion or imminent danger thereof can embody them for service.

It must be borne in mind that there has seldom been any difficulty in supplying the ranks of the defensive forces with recruits; for, should recruits fail to present themselves as volunteers, Parliament would be ready (judging from the experience of the past) to concede to the

Crown the power of raising them by conscription; but that with regard to the offensive forces the same observation does not apply; on the contrary, great difficulty has always been experienced in keeping their ranks filled with recruits to meet even the waste which war occasions, and far greater difficulty in increasing their numbers.

V. *Reserve Forces in British Possessions Abroad.*

Particulars of these forces are given in the book before referred to.

The approximate total numbers are 303,000 men and of these about 220,000 are infantry. The cavalry exceed 5,000.

These numbers are considerable, but they appear to be very insufficiently organized and trained.

The establishment of the active militia of Canada alone amounts to over 150,000 men, but it has had very little training.

May not this be accounted for by the unwillingness of the Colonial Legislatures to provide for the cost of the permanent staff, which in our own militia forms so large a proportion of the cost of training? In the colonies much higher pay would have to be given to secure the services of competent instructors, who would, as in England, have little or nothing to do for 11 months in the year.

For this reason I have, as one of the main proposals of my scheme for Army Organization, advocated the retention in certain colonies of a full number of battalions, containing a small number of men, but a full proportion of officers and non-commissioned officers.

The following is an extract from the proposal:—

"In certain of the British colonial possessions which are required to contribute to their own defence, local reserves should be organized and trained so as to form part of the Imperial Army.

"This may be done by reducing the number of private soldiers in the battalions and affiliating to each battalion a proportion of local reserves.

"This would not only lessen the drain on this country for men in time of war, but would effect a saving of expenditure in training local reserves.

"It would moreover be possible to train during the drill season two or more batches of reserves with each battalion, so that the number of men held in reserve might be much larger than that required to fill up the ranks of the battalions.

"Emigration to Imperial colonies might be encouraged by allowing the men to settle subject to service in the reserve, and the 'outflow through emigration,' which is now an 'obstacle to recruiting,' might be turned to account in reducing the drain on the mother country for soldiers to defend her own colonies."

There appears to me to be no reason why the battalions in British North America should not be made up so as to provide nearly the whole of the training staff for the local militia.

Extra duty pay should, of course, be given to officers, non-com-

missioned officers, and men during the time they are employed as instructors of militia.

From the foregoing sketch of our Military Forces it will be seen what a very large body of men there is to be dealt with, and how much may be done by devising a comprehensive scheme of organization, and carrying it out, if necessary, gradually.

The organization of these forces would appear to be a duty that devolves on the executive Government of the day, subject of course to the approval of the Parliaments concerned, by whom any necessary funds would have to be provided. I apprehend that little if any legislation is necessary to give effect to an efficient organization.

To sum up the numbers are as follows :—

I. Trained and more or less organized,			
a. Regular forces (British and Indian) ..			213,357
b. Local Army in India			137,020
Say ..			350,000
II. Trained but not organized,			
Home.	Establishment.	Trained.	
c. Reserves	80,000	18,000	
d. Militia	134,037	91,000	
e. Yeomanry ..	16,185	16,000	
f. Volunteers ..	215,812	155,000	
Total, Home Reserves enrolled	446,034	280,000	
g. Colonial Reserves (probable) number		100,000	
Total, trained but not organized (say)			380,000
III. Neither trained or organized,			
h. Incomplete Establishments, Home Reserves		167,000	
i. Trained Bands		200,000	
k. Colonial Reserves (balance of 303,000)		203,000	
			570,000
Grand Total of Imperial Forces (say)			1,300,000

Before entering into further explanation of the changes which I advocate, I desire to bring to your notice certain additional information and facts which it appears to me should be prominently before you during a discussion.

You are all doubtless aware that for many years prior to 1847, the

recruits for the regular Army were enlisted for life, although usually discharged to pension of 1*s*. per day at the end of 21 to 24 years' service.

The Army Service Act, 1847, limited the first period of engagement to 10 years, for the Infantry, and to 12 years for the Cavalry, Artillery, and Engineers. If engaged for additional periods to complete 21 years' service, in the Infantry, Artillery, or Engineers, or 24 years in the Cavalry, pensions of 8*d*. per day with an addition for good conduct were given on discharge.

The objects in view in making limited enlistment compulsory, appear to have been as follows :—

(1.) To induce a larger proportion of young men to enter the army, and by ameliorating and shortening the conditions of service, to cause it to be deemed a punishment to be turned out of it.

(2.) To throw back on the country a larger proportion of men who had a regular military training, and who would in time of need be available for national defence. These men to be encouraged to join a reserve force.

(3.) By discharging the men before they had completed the service necessary to entitle them to a pension, and during a period of life at which they could revert to industrial employments, the estimates would have been eventually relieved of a proportion of the non-effective charges.

From the years 1848 to 1854, while the Army was maintained on the peace establishment which for so long a period had been its normal condition, the provisions of the Army Service Act, 1847, were found to answer necessary requirements; but when in 1855 there was, consequent on the Crimean War, an extraordinary demand for recruits, it was found necessary to shorten the period of enlistment, and temporary powers were obtained to legalize enlistment for a shorter period, to be regulated by Order in Council. Under these powers, which have now lapsed, men were enlisted for the duration of the war.

During the years 1864–5 there was difficulty in obtaining a number of recruits sufficient to meet the losses resulting from deaths, discharges, and other ordinary causes, and the deficiency was likely to be still further increased on the expiration of the term of service of the men who had enlisted for 10 years during the Indian Mutiny of 1857–8.

In April 1866, a Royal Commission was appointed to enquire into the causes of the deficient supply of recruits; to suggest remedies for the removal of this deficiency; to report on the operation of the Army Service Act, 1847; on the expediency of retaining powers over men after their discharge; the periods for which men should be engaged; the foundation of a reserve force; and the adoption of a system of recruiting for general service.

The Report of the Commission was made public in October, 1866, and the blue book which contains the evidence gives elaborate statistics shewing the working of the Army Service Act, 1847, together with outlines of the laws which then were, or had previously been in force for regulating Military Service.

As this Report sets forth the facts and statistics on which subsequent legislation has been based, and is the official document to which reference may most appropriately be made for purposes of discussion, the following extracts, which bear on the subjects proposed for consideration have been selected for insertion in this paper :—

In reference to the deficient supply of recruits during the years 1864–65, and the causes of such deficiency, the Commission reported that " the evidence which has been given before us and the returns " in the Appendix to our Report all tend to show that during the " last two years the number of recruits raised for the Army has not " been sufficient to supply the demand. The deficiency, however, is " not such as to create uneasiness, as we think that it may be traced " to causes which, for the most part, admit of remedies being applied " to them.

" For many years there existed in this country two distinct kinds of " military organization. The one was the regular Army, in which " the service was voluntary, and which was under the more imme- " diate control of the Crown ; the other the Militia, in which the ser- " vice was compulsory.

" For some time past the principle of compulsory service has been " suspended, and by this departure from the old system, and by " adopting the same mode of filling the ranks of the Militia as is " resorted to for the Army, the recruiting for the latter in time of " peace has been, to some extent, interfered with ; and to this may " be traced one of the causes of the present deficiency of recruits for " the line."

After enumerating certain improvements effected in the condition of the soldier, the Report states that, " notwithstanding these great " improvements, it is to be feared that there is no increased dispo- " sition on the part of the youth of the country to look to the Army " as a profession.

" The constant outflow through emigration, the great demand for " labour in all branches of industrial employment, and the consequent " rise in the rate of wages, form, no doubt, a principal obstacle to " recruiting at the present time ; but we are informed that the mode " of conducting the recruiting service itself is also far from satis- " factory."

With regard to the remedies required to remove the deficiency, the Report states :—

" We have examined various witnesses as to the benefits which " might result from localising different regiments, or connecting them " with special counties or districts ; but we cannot say that this would " be a desirable or expedient course.

" On the other hand, strong evidence has been laid before us show- " ing the advantages resulting to recruiting from a local connection " being maintained between individual corps and certain localities. " Men enlist much more freely in corps which already contain a number " of their friends and acquaintance ; and such connections should.

" therefore, we consider, be in every way encouraged. Much may be " done in this direction by strengthening the relations that exist " between particular corps of the Army and particular Militia regi- " ments, whether arising from county denomination or other circum- " stances, and the object might also be facilitated by the line regi- " ments supplying good non-commissioned officers to the corresponding " Militia regiments, and by directing the volunteering from each " Militia regiment to one, or even two or three, regiments of the " line."

Then follow proposals for facilitating the transfer of recruits from the Militia to the line; for the grant of additional pay, good conduct pay, clothing, and rations, and the retention of pensions for long and faithful service, as means for increasing the popularity and efficiency of the Service.

In reference to the operation of the Army Service Act of 1847, the Report states " that limited enlistment is by no means a new feature " in the Army, and that the period of service was at one time as brief " as three years; that the framers of the Army Service Act, 1847, " have been disappointed in the expectation that every person who " declined to engage for the second period of service would enter into " an arrangement whereby he might be enrolled in a reserve force, in " which, under certain regulations, he might acquire a right to pen- " sion; and thus an army of reserve would be formed on which the " country might rely in times of exigency; and that the reserve " force, as constituted by warrant in 1859, has been a complete " failure.

" There appears, on the part of the military witnesses, a strong " opinion against the present law; but when they are asked whether " it would be expedient to recur to the practice of enlisting nominally " for life, but practically for 21 years, nearly all of them admit that " such a recurrence is out of the question.

" Some of the witnesses recommend a lengthened period for a first " engagement, even up to 18 years, but most of them concur in fixing " the first period at 12 years, and in making it the same in all branches " of the Service, with a second period of nine years, for which every " soldier should serve to entitle him to a pension for life.

" Looking to the weight of evidence given on this subject, we " recommend that a change be made in the present law, and that the " periods of service be altered to 12 years for the first period, and 9 " years for the second period, for all branches of the Service, making " in the aggregate a service of 21 years, which every man should " complete to be entitled to a full pension for life.

" Soldiers are by regulation permitted to purchase their discharges, " and this permission is considered a boon, and is frequently asked " for. We do not recommend its withdrawal; but, considering the " high rate of wages to be obtained in civil life, as compared with " those which prevailed at the period when the present price of dis- " charges was fixed, we are of opinion that the scale should be con- " siderably raised.

" A return in the appendix shows that during the five years ending

" 1864–65, out of 25,403 soldiers whose time of service had expired, " 11,343 left the Army, whilst 14,060 remained.

" A comparatively small proportion of non-commissioned officers " actually left the Army during a period of eight years, averaging " during each year, for all branches of the service, only about $1\frac{1}{2}$ per " cent. of the sergeants, and about double that percentage of the " corporals."

The Commission stated that,—

" In regard to the retention in the Army of men after the expira- " tion of their first period of service, there can be no doubt that if we " look only to the efficiency of the Army, and take into consideration " the strong opinions which pervade the minds of its officers, it is not " desirable that too many of the old and seasoned soldiers should be " lost. Nor do we think that such is the case.

" The following table shows the comparative ages of cavalry and " infantry, in proportion per thousand of strength; the age and ser- " vice of the soldiers composing the cavalry and infantry are not less " favourable for military efficiency at the present day than they were " in 1846, just prior to the introduction of the Limited Service Act, " when enlistment for life was the rule:"—

Ages.	Cavalry.		Infantry.	
	1846.	1866.	1846.	1866.
Under 18 years	3·2	14·2	52·3	17·8
18 to 20 "	74·0	79·9	124·3	114·6
20 to 25 "	339·0	304·0	342·6	275·2
25 to 30 "	322·5	369·0	277·0	356·2
30 to 35 "	137·0	148·0	98·0	150·8
35 to 40 "	78·9	57·2	84·3	74·4
40 to 50 "	43·4	27·4	21·3	10·8
Upwards of 50	2·0	0·3	0·2	0·2

This table shows that out of 1,000 infantry soldiers, 407·6 were under 25 years of age; and only 85 exceeded 35 years.

" In the artillery nearly two-thirds of the men entitled to take " their discharge re-engage, and in the Engineers about three-fifths.

" In the cavalry and infantry the proportion of re-engagements is " considerably smaller."

Then follow sundry recommendations, having for their object an augmentation of the number of re-engagements:—

It was also recommended " that, on the score of health alone, men " should not be sent out to India under 20 years of age. We further " advise, on the ground of efficiency, that none but thoroughly trained " soldiers should be sent abroad."

Further, " that in any modification of the Army Service Act, a dis-

" cretionary power should be given to the Secretary of State for War " to authorize the re-engagement of men under orders for foreign " service for such periods, not exceeding 12 years, as may extend " their engagement to the full period during which their regiment is " expected to remain abroad, accompanying their re-engagement with " a graduated scale of bounty, according to the additional periods " engaged for. Any men who, on their return home with their regi- " ment, still require some additional service to entitle them to a pension " for life, should be allowed to enter into a third engagement, but " without bounty, in order to enable them to complete the full period " of 21 years.

" That inducements be given to soldiers now serving in India to re- " engage in that country after their first period of service is expired.

" The prevalent idea of the great dislike to service in India appears " to be unfounded.

" Out of 18,804 soldiers whose first period of service expired during " the six years ending in 1865, about one-half, viz., 9,431, re-engaged, " leaving 9,397 to be embarked for England; and we think that " with other moderate inducements, such as a small increase to the " present scale of bounty, a much more favourable proportion might be " obtained.

" Before closing our remarks on this portion of the subject, we " would observe that the prolonged concentration of the military " forces at home in large camps is a source of dissatisfaction. No " doubt the greatest benefit is derived from bringing considerable bodies " of troops of all arms together for exercise in summer; but we think " that when the drill season is over the troops should be dispersed " throughout the country, that they may be seen by and mix with the " masses of their countrymen, and thus stimulate their military feeling " and act as recruiting centres during the winter, which is the period " most favourable for obtaining recruits."

With regard to the system of recruiting, the Commissioners recommended the establishment of " a distinct staff for recruiting " purposes, which should be under the immediate orders of the Com- " mander-in-Chief, and its head responsible to him through the " Adjutant-General. This staff should consist of an Inspector-General, " not attached to any particular district, but having under him as " many district officers for assistant inspectors as may be found neces- " sary fully to occupy the whole country, with subordinate officers " again under them.

" The organisation should be completed by a certain number of non- " commissioned Officers from each corps of the Army, supernumeraries " to the establishment, who, while retained on the recruiting service, " should be entirely at the disposal and under the control of the re- " cruiting officers."

They observe that bounty-money is usually spent in riot and dissipation, and tends to encourage desertion, and do not recommend an increase. An increase of bringing-money is, however, suggested.

They state that " we would by every means encourage enlistment " at head-quarters of regiments, and it seems to us that if soldiers

" going on furlough were empowered to beat up among their friends " for recruits, for whom they would receive the regulated bringing-" money, some desirable additions might be made to the ranks of their " respective regiments.

" In reconstructing the system of recruiting, great attention should " be paid to the medical examination of recruits.

" It would be a great advantage if this could be done entirely by " medical officers, subject to military authority."

But no arrangement by which this system of enlistment could be made general was proposed.

The establishment of training schools as a means of providing recruits is suggested, on the ground that those for the Navy have been most successful.

In reference to the employment of soldiers, the Commissioners observe:—" It appears to us that in the infantry especially the soldier " has a large amount of spare time on his hands, which might be turned " to more profitable use than is now the case. To this end we would " suggest that the soldiers should be taught industrial trades, and be " encouraged to work at them when their doing so would not interfere " with their military duties. They should all receive instruction in the " use of the spade and mattock, so as to be able to wield them effectively, " and to throw up earthworks with facility—a knowledge from which " the greatest advantages might be derived on active service."

The Commissioners conclude their report by reference to the formation of a reserve force, and state " that it opens up a very large " question, the decision of which rests rather with statesmen and " Cabinets than with a Commission such as that of which we are " members.

" Recent events, however, have taught us that we must not rely in " future on having time for preparation. Wars will be sudden in their " commencement and short in their duration, and woe to that country " which is unprepared to defend itself against any contingency that " may arise, or combination that may be formed against it.

" The first duty of those who preside over the administration of the " Army is to look to its constitution.

" As a peace establishment, and having in view nothing more than " the proper provision of that military protection which we are bound to " afford to our Indian territories and our extended colonial possessions, " the Army is at present barely sufficient for these purposes; one, and " not the least cause of its unpopularity as a service, arising from the " fact that the soldier must spend two-thirds of his time in a state of " expatriation.

" Under these circumstances we must look more to our Army. We " think its present strength is barely sufficient for a period of peace, " and the question is, how we can most readily and speedily increase " it through the means of a reserve force consisting of men who have " already received that training in its ranks, but may have fallen " back into the ordinary duties and callings of civil life. We " have already stated the fact that the 'Army of Reserve Force,' " as constituted under the Warrant of 1859, has been a complete

" failure, and the measures which we have proposed to induce more
" men to re-engage in the regular Army, will no doubt tend still
" further to check its increase. Under these circumstances we are not
" prepared to propose any plan as one that may be relied on to secure
" a large army of reserve.

" Having thus given our opinion on the different points referred to us,
" in conclusion, we must observe that we are perfectly aware that our
" suggestions, if acted upon, will tend to increase the cost of the Army.
" But, when we consider the vast interests at stake, and the immense
" amount of wealth and property accumulated throughout the country
" as well as in our large cities, we cannot believe that the nation will
" hesitate in paying what, after all, will amount to a very trifling rate of
" insurance; and by maintaining the peace establishment of the Army
" in a sound and satisfactory condition, and having in its support a
" well disciplined reserve, we may thus arrive at a military organiza-
" tion such as shall give confidence to the country, and enable all
" your Majesty's subjects to prosecute without distraction those duties
" and pursuits in which they may be engaged."

It is impossible to read that Report without feeling that there *may* be solutions to the problems involved different from those proposed by the Commission, and as the *policy* of the results which the Act of 1847 was intended to bring about has not been questioned, it is submitted that proposals having for their object the attainment of those results are deserving of serious consideration.

In referring to the failure of the Act to produce the expected reserve force, may not this be accounted for by the fact that of the ten years' men more than half re-engage, and that of the non-commissioned Officers only 4½ per cent. leave the Army in each year.

It is therefore for consideration, whether in place of inducing the men to re-engage and hold on for pensions at an annual cost per man which, including the value of pensions, is about double that of young soldiers, and about ten times that of a reserve soldier, it would not have been worth while to have tried the opposite course, of largely reducing the period of compulsory service, and of requiring all to leave the Army, except men of superior character and soldier-like qualifications, and those who have a claim to permanent employment in respect of colonial or active service, offering them the alternative of remaining on the rolls of their regiments for service in the reserve, with a liberal retaining fee.

It appears inconsistent to urge the importance of a reserve force consisting of men who have already received training in the ranks of the Army, and to propose measures that would have the effect of checking the increase of such reserve.

It may be interesting to examine the financial effect of re-engaging men for a second period of service (viz., 12 to 21 years), as compared with a system of enlistment for short (say 3 years) service.

There is no official published statement of the present pay and allowance of a soldier of under 3 years as compared with one of over 12 years' service, but excluding bounty, barracks, medical attendance,

and some other items which I cannot exactly calculate, and which are common to all engagements, it will, I think, be found that the proportion is as follows, supposing the men to be well conducted :—

Under 3 years	£32 per annum.
12 to 21 years (average)	£40 „

So that if, in place of re-engaging the time-expired man, he were replaced by a young soldier, there would be a surplus of £8 per man per annum, to defray the cost of keeping the older soldier in a Reserve Force, should he be inclined to enrol himself.

The foregoing refers to the cost of the men while serving. But we have also to take into consideration the expectation of pension, the dead weight which the Legislation of 1847 was intended to lighten.

Referring to the tables attached to the Report of the Recruiting Commission, we shall find that more than one-half the recruits are enlisted under 20 years of age. The average age of soldiers who have completed 12 years' service may therefore be taken at 32, and they would be entitled to discharge with pension at 41. The average amount of pension for men who serve the full time is, I believe, about 1*s*. 1*d*. per day, or say £20 per annum.

If we turn to the annuity tables, to be found in the Postal Guide, page 44, we shall see that the lump sum to be paid at 32 years of age for a pension of £1 per annum, to commence at the expiration of 10 years from the date of purchase, would be £10 4*s*. 4*d*., or for a pension of £20 per annum, £204 6*s*. 8*d*., or, if paid by annual instalments, the annual payment would be £23 2*s*. 4*d*.; so that if the Army Estimates were to be relieved of the pension list, and the cost of paying and auditing the pension accounts—a measure which I believe would find favour with some of those best able to form an opinion on the subject—the War Department should pay to the Post Office Department a sum of about £23 per annum for every soldier of 32 years of age, re-enlisted under the Army Service Act, 1867. I believe that about 30,000 have re-engaged under the inducements offered on the recommendations of the Recruiting Commission. If the post office tables are applicable, the annual cost to the country of these men is not far from £600,000 per annum in excess of that which will appear in the estimates while they are serving.

A fact of interest in connection with the pension list is, that although there are 61,748 men in receipt of pensions, the numbers enrolled for service in case of emergency is only 14,100.

I will now examine the financial effect of holding out an expectation of a pension as an inducement to men to "enlist for a short term of "enrolled service, with a liability to afterwards serve in a reserve force," as advocated by Lord Grey, in his letter of 23rd August, 1866, Appendix Y, of the Report of the Recruiting Commission.

It may be assumed that it would not be necessary to grant pensions until the end of thirty years' total service or 50 years of age, being ten years less than the age fixed for civil service pensions.

Supposing, as before, the average age of engagement to be twenty years, the lump sum to be paid down for a pension of £20 per annum, to commence at 50 years of age would be about £70, or about one-third the value of the pension of the re-engaged soldier of 32 years of age. The annual cost, if paid by instalments, would be about £4, as compared with £23.

If, therefore, the tables of the Post-office may be accepted as approximately applicable, there can be no doubt of the financial result of the short-service scheme, so far as pensions are concerned.

It is calculated that if in place of re-engaging 30,000 time-expired men we were to give them immediate pensions of from 4*d.* to 6*d.* per day as retaining fees for service in the reserve, with a promise that they would have pensions of £20 a year each on attaining 30 years' total service, and if we were to replace them by 30,000 younger soldiers, the cost to the country would not be so great as that of keeping the veteran soldiers in our regular Army, and we should within the next two years have a very respectable reserve composed of men who had received their training in the ranks of our Army.

The calculation on which this statement is based is as follows:—

	£	£
1. Annual cost of 30,000 re-engaged men (12 to 21 years' service) at £40 per annum		1,200,000
2. Annual cost of 30,000 young soldiers at £32	960,000	
Retaining fee of 30,000 reserve soldiers at £8	240,000	
Total annual cost of 60,000 men		1,200,000
3. Present value of pensions of £20 per annum payable to 30,000 men of 32 years of age at 10 years from re-engagement		6,130,000
4. Present value of 30,000 pensions of time expired men payable after 20 years' service in reserves	3,200,000	
Present value of 30,000 pensions of young soldiers payable 30 years hence	2,097,000	
Total value of pensions		5,297,000

The annual expenditure for 30,000 young and 30,000 reserve soldiers being the same as for 30,000 re-engaged soldiers, the estimated saving in respect of the capitalized value of pensions is about £800,000.

It is an experiment, of which we have no previous experience, to enlist men on a *present* bounty for *future* active service before an enemy abroad; in effect, to give the reserve men all their advantages in time of peace, and to wait until time of war for their service. Hitherto a present payment has been the inducement for men to leave their homes and engage in active service before the enemy, and whether men who

have long before spent their bounty, and, therefore, have nothing to look forward to but the hardships and hazards of actual warfare, will be ready and willing to enter upon active service, must be, to say the least of it, extremely doubtful.

Enlistments for ordinary Army service are, moreover, made of men who are single, unmarried, and physically capable of serving. These facts being ascertained, the man at once enters upon service, and is constantly under military and medical "surveillance," so that though marriage or malingering or self-mutilation are not impossible, yet Her Majesty's Regulations forbid the one, and the other is a crime punishable under the 81st Article of War.

But with the new reserve force the case will be widely different. For eleven months in each year they will be civilians, and therefore can marry at any time without the breach of any regulation; and their physical capabilities may be altered by accident or design without incurring any punishment. Either or both of these incidents would gain them a release from their enlistment, or compel the Crown to take men into the service who would not otherwise have been accepted.

It is, therefore, very desirable that men enlisted for service on a contingency should have a prospective pecuniary inducement to appear when required.

Subsequent to the appointment of the Recruiting Commission, and while they were receiving evidence, war was declared between Austria and Prussia, and the astonishing result of the three weeks' campaign which ended in the defeat of the Austrians at Sadowa, and brought the war to a conclusion in a few weeks, caused increased public attention to be directed to our Military institutions, and people began to ask in what condition we should be were a hostile force to succeed in effecting a landing on our shores.

In the absence of any proposal from the Commission to provide for such contingency, the Prussian Military System under which such successful results had been obtained in Germany, was naturally suggested as a model whence an improved organization might be devised.

As the adoption of one or more of the principles of the Prussian system has been advocated by nearly all who have written on the subject of army organization, I have procured information from Lieut.-Colonel Cooke, R.E., of the Topographical Department, explanatory of that system. The Prussian system embodies three principles; the first, a general conscription with liability of every able bodied man to serve in the regular army or in its reserves between the ages of 20 and 27, and subsequently in the "Landwehr" between the ages of 27 and 32. All not serving in the army or Landwehr being liable to serve in the "Landsturm" between the ages of 18 and 42 inclusive.

This principle could not be applied to this country, mainly for the reason that our regular army is not solely defensive, two-thirds of the number being constantly on Colonial or Indian service.

The second principle, namely that of assigning to each regiment a particular territory, in which it is usually quartered, and attaching to

it a reserve and "Landwehr" battalion in which all eligible persons residing within that district must, for some time of their lives, be enrolled, has also been deemed inapplicable in this country, but it is submitted that a modification of the plan could with advantage be adopted by, as already suggested, attaching to each of our regular regiments a battalion for service in India or the colonies and a proportion of the Army reserves. Our militia, volunteers, and trained bands would correspond with the Prussian Landwehr and Landsturm.

The third principle of the Prussian system is to lighten so far as consistent with reasonable efficiency the military service, so as not to interfere with the industrial occupations or education of the young men who come up for service in the standing Army. And to specially shorten the service of those who are willing to relieve the state of the cost of their maintenance and equipment.

This is a principle which, it is submitted, admits of extensive application in our Army, and in its reserves.

Looking on military defensive service of the State as a tax to which all men are liable to contribute either time or money, there would not appear to be any reason why some privileges, or some exemptions in respect of taxation should not attach to those who give up, without adequate payment, their time to qualifying themselves for taking an active part in the defence of the nation.

In round numbers the annual pay and allowances of a regular private soldier are about £32, of a militiaman £6, and of a volunteer, £1 10*s*. If any members of the two latter classes will give up their time and spend money in order to attain a degree of efficiency nearly equal to that of the regular soldiers, they should be entitled to every consideration.

Lieutenant-Colonel Cooke has also lent me an abstract prepared by him of the militia laws in force in the State of New York, which is very interesting, as showing how the Prussian system has been adapted to meet the case of a Republican constitution.

The distinctive features of the New York system are—(1). That all able bodied men are liable to serve, but that most service is commutable by fines; the greater part of the funds to defray the expenses of the militia are raised by fines levied by non-attendance at drills, &c. (2). That subject to an examination as to fitness, and an inquiry as to character by the Commander-in-chief, the officers are elected, the company officers by their companies, the field officers by the company officers, and the brigadiers by the field officers.

During the months which elapsed between the publication of the Report of the Recruiting Commission, October, 1866, and the assembly of Parliament, February, 1867, articles appeared in more than one newspaper, notably in the "Pall Mall Gazette," and "Saturday Review," advocating the principle of enlistment for short periods of enrolled service, with liability to be called out on emergency during a longer term, and proposing separate engagements for Colonial service.

Concurring as I did in these views, I gave some consideration to the details necessary to give effect to these principles, and I came to the

conclusion that by adopting a regimental organization such as I have indicated, particulars of which are given in the printed tables, the system might be applied to our Army with but little disturbance of existing arrangements, without injuriously affecting existing interests, and without any expense beyond that which would be due to an addition, if any were needed, of the number of men enrolled for service. The scheme was brought to the notice of the Secretary of State for War, in January, 1867; it was subsequently printed in April, 1867, and submitted for consideration, in contradistinction to plans by which the Reserves, to fill up the ranks of the regular regiments, were proposed to be trained by and attached to the Militia.

I will now proceed to explain the main features of the organization which I advocate, and to state the points which are submitted for consideration.

The heads under which it appears to me the subject should be considered have already been stated (page 312).

Under the first head (A), that which involves political consideration, it is not proposed to alter any existing legislation at present, but if difficulty be experienced in making up the Reserves to the numbers authorized by Parliament, it is recommended that no opportunity should be lost of passing into them any of the recently re-engaged soldiers who may be willing to leave their regiments with the liability to come up when required; their places in the regiments to be taken by young soldiers.

The calculations showing that this would financially be the better course, have been already submitted, and if the military advocates for re-engagement were asked whether they would recommend the expenditure of a given sum of money in the re-engagement of 30,000 men, of 30 to 35 years of age, or whether, the funds being limited, they would prefer that these 30,000 men should be passed into a Reserve force, with power to call them up to rejoin their regiments, their places in the ranks being taken by 30,000 younger soldiers, of 18 to 25 years of age, I have little doubt but that they would prefer the larger number of men.

I apprehend that it is in the power of the Secretary of State to make regulations for giving effect to this suggestion.

If after some experience of the working of the system it should be found desirable to shorten the period for compulsory service, from two-thirds to, say, one-third, the period of the first enlistment, the alteration of a word in Clause 55 of the Mutiny Act, would give power to the Secretary of State to use discretion in the matter.

Under the second head (B) it was proposed (page 312) to consider the *numbers*, *training*, and *organization* of the combatant troops.

1. As to numbers, I have already stated (page 319) the authorized establishments, and it is not proposed to increase the establishments of the British Infantry forces, or of the Home Reserves (see Table III).

The only proposal submitted, with the object of increasing the num-

ber of men is one that was suggested to me, viz., that we should turn to account for purposes of national defence the large number of persons holding civil employment under the Crown.

On reference to the Navy and Civil Service estimates, it will be found that there are over 27,000 subordinate civilians employed by the Admiralty, Customs, and Excise Departments; over 15,000 are employed in the dockyards alone; these men might be trained by the staff of the proposed garrison battalions, with which they could, in the event of war, be associated for the defence of the fortifications that guard the establishment in which they earn their livelihood. The superior officers of the departments should be required to officer these men.

Having settled the *number* of men, the next step is to form them into "Companies," "Battalions," "Regiments," and "Brigades" for purposes of *training* and inspection, and to admit of their being readily formed into *Divisions* or *Army Corps*.

The present and proposed regimental establishments will be found in Table I, the main features of the regimental organization which is submitted for consideration are:—

1. That keeping up as we do infantry officers and non-commissioned officers in numbers sufficient to train and command 53,000 men in excess of our peace establishments, those officers and non-commissioned officers should be employed to supervise, train and command the 50,000 reserve men which Parliament has authorized the Secretary of State for War to raise and organize as a reserve for general service (See pages 313, 314, 315).

2. For the training and organization of the pensioner reserves, the formation of garrison regiments is proposed (see page 315), the composition and distribution of these corps will be found in the tables.

3. That the project may be carried out gradually and without a reduction of the old established regiments. The percentage of Officers and the number of men per company will be the same as at present and, taking into account the regimental reserves, the proportion of combatant officers to men will be sufficient, being in excess of that in the armies of the great Continental powers, viz.:—

British army	1 officer to	28 men.		Austrian army	1 officer to	40 men.
French „	1 „	33 „		Prussian „	1 „	49 „

The service battalions are proposed to be of nearly the same total strength as the infantry battalions now serving in India, and the brigades of about the same strength as at present.

4. By organizing the infantry regiments in two battalions and increasing the number of battalions on home service, it will be possible not only to organize our army reserves without additional staff or establishment, but to so arrange the military districts that each shall form the nucleus of an army corps with staff complete.

Some important improvements, many of which are suggested in the

report of the Commission on Recruiting could also be carried out, viz. :—

To facilitate the assembly of troops in camps during summer, and their dispersion in country quarters during winter.

To establish more permanent head-quarters for the several regiments, and thereby add to the comfort of the officers and men—establish local connections for recruiting,—admit of greater facilities for the useful employment of the men, and for their instruction in trades.

To define the period of service in India and the several colonies, and adapt it to the climate and conditions of each station. Many of the objections which soldiers now have to colonial service would be removed.

To conduct recruiting regimentally and without an expensive recruiting staff—the men in reserve, acting as recruiting agents to their regiments, and keeping up local connections.

By requiring reserves to be exercised at the head-quarters of regular regiments, the period of year at which the annual exercise should take place could be arranged so as to interfere as little as possible with the industrial occupations of the men. In certain cases arrangements might, with the sanction of the Commander-in-Chief, be made for exercising men in reserve with volunteer corps or militia regiments.

It is believed that the arrangements proposed would not only attract to the ranks of the Army a large number of intelligent men who would not now think of enlisting, but it would have the effect of making service in the army reserve force more popular than service in the militia.

In order to carry out the revised regimental organization, it would be desirable to select officers for the command of regiments and battalions, and that the appointments should be made without purchase, probably from a general list of field officers.

The pay of the Officers in command of regiments to be made equal to that of a regimental Colonel in command of a brigade of artillery, and that of an Officer in command of a battalion equal to that of a colonel 2nd Commandant of Marines.

This would involve, an increased annual expense of about £26,000 to be met by a reduction of the separate recruiting staff, which now costs over £27,000.

These appointments would give a professional opening to regimental officers, other than that of staff employ. The lowest staff position which a Captain can hold, is now better paid than the command of an infantry regiment, and it is not surprising that some of our best regimental Officers, especially those who, while desirous of making the Army their profession, cannot afford to serve for a pay little, if any in excess of the interest on the purchase money of their commissions, should take the first opportunity of giving up their regiments for staff appointments of comparatively minor importance.

I do not think that so long as the establishment of Officers is, as at present, in excess of the number actually required to train and com-

mand the men actually embodied, and while there is a demand for commissions in excess of the supply, any great increase of the standing pay of the regimental Officers could be proposed, but the position of regimental officers might be improved without any great expense, by giving the rank of major to captains of a certain standing, as it now is to Lieutenants in the Navy, and also as a reward for service in the field or other *good* service.

We should under the proposed regimental organization no longer have the frequent changes of establishment which have given rise to grievances on the part of officers.

A serious drawback to military life as a profession is the impossibility (without a sacrifice of promotion which is fatal to future advancement) of exchanging, when for sufficient reasons individual officers are unable to accompany their regiments on ordinary colonial service. By arranging the rolster for colonial service regimentally, it would in such cases be possible, without injury to any one, to allow exchanges of home and colonial duty, and an officer who did not object to an extra turn of colonial service, could, as a private arrangement, receive a bonus for taking the duty of another. It would of course be necessary to keep a strict rolster, and to specify the number of years for which the officers should serve with the battalion in the colonies. It would also be necessary to remove staff officers from the regiment, or to make them supernumerary, so that their special employment would not throw an undue share of duty on others. A reduction of regimental officers has been proposed to enable this to be done, and if further reduction were requisite, it would be carried out by not filling up all the vacancies among the subalterns of the home battalions.

The inconveniences of the purchase system would be reduced to a minimum by the adoption of Captain Vivian's proposal for reducing the regimental ranks.

As no increase in the total numbers of the British establishments is proposed, it is necessary to show how the men and battalions may be distributed under my scheme so as to meet the requirements of the Service.

This I have done in Tables II and IV, and it will be seen that if the composition of battalions which I suggest be adopted, there would not, in any grade, be an excess of present establishments, and consequently no increased expense.

These details may, however, be modified without affecting the principles advocated. I worked them out and have had them printed in order to satisfy the meeting that the scheme is practicable, and could be carried out without additional staff or establishments, but I do not propose to enter into explanation of them, unless requested to do so.

The only point which calls for explanation is, that I have adopted eight company battalions for two reasons—1st, to admit of an increase of battalions; 2nd, because, under present regulations, flank companies are done away with. I propose, however, to have four battalions in a brigade, in place of three.

Having settled the establishment of "battalions" and "brigades," the

next step will be to *organize* them into "divisions" and "army corps," and to settle the precise distribution of the forces.

The project for an army corps laid down in the "Regulations for "the equipment and supply of stores by an Army in the field" is based on the *infantry* force, viz., two divisions (or four brigades) of infantry, of the total numbers of 10,000 men.

The units for the formation of an army corps of any required strength may be taken to be a division of infantry and a brigade of cavalry. To each of these a proportion of field (or horse) artillery and train would be attached, and a proportion of engineers would be told off to each infantry division.

So long as the proportions are laid down, and the troops are distributed throughout the kingdom so as to be readily brought together for annual exercise in those proportions, there is, I submit, no necessity for making it a condition that the forces shall be distributed in corps of "equal" strength; nor would it be practicable to do so without large expenditure in the erection of barracks, &c.

I have, therefore, prepared a project, Table IV, showing the peace distribution which I would propose. Under this project, the regular infantry would be so distributed that brigades might be annually assembled for exercise in the camps proposed for the several districts, and in four out of the six districts there would be cavalry brigades.

I have shown the number of infantry, of infantry reserves, and of militia, which I would propose to attach to each district for supervision of training, and for the purpose of being brigaded with the line. These numbers are given in the diagram before the meeting, and the distribution is further illustrated by a map, on which are shown the suggested positions of the head-quarters of districts and brigades, and of the camps.

In preparing the project I have arranged the districts mainly in reference to the railway communications and existing barrack accommodation, so placing the head-quarters that they may, as regards postal communication, be conveniently situate, in reference to the outlying brigades and stations.

Thus the southern division, with its head-quarters at Aldershot, and which would be the nucleus of an army corps of over 60,000 infantry for the defence of the South Coast, would have the command of the South-Western Railway and its branch lines.

In time of war the brigades of line regiments at Portsmouth and Gosport would join the moveable force, their places in the garrison being taken by the Pensioner Reserves and Militia and Volunteer battalions.

It would be the duty of the Generals commanding districts and of the Brigadiers to make themselves thoroughly acquainted with the whole of the defensive resources and requirements within their respective commands, including the arrangements for transport, the means of procuring at short notice additional horses for the cavalry and artillery, the positions to be entrenched, and all the numerous arrangements necessary for turning the forces under their supervision to the best possible account in the event of war or invasion.

The arrangements for the management, repair, or destruction of the railway communication within the district should be carefully prepared in concert with the officers of the railway companies, and of those of Volunteer Staff Corps who have taken up that subject.

With a peace organization and distribution of the regular and militia forces such as I have here indicated, and a corresponding organization and distribution of the cavalry, artillery, and engineer corps, there would be no difficulty in putting into the field a defensive force far in excess of the 200,000 men which was suggested as one of the conditions of our problem, nor would there be any delay or difficulty in organizing an expeditionary corps of a total number of 100,000 men.

In respect of the yeomanry and volunteer forces, all that appears necessary for their more perfect organization, is to make arrangements by which brigades formed of these forces should be manœuvred with those of the line and militia, and to place the inspection under the Generals in command of districts.

I doubt the expediency of placing volunteers in the same brigades as regular soldiers. The regulations under which they serve differ so much from those of the regular Army, and the fact of the men being taken from a different class in life, would appear to afford sufficient reasons for forming brigades of exclusively volunteer battalions. This, however, is a subject for discussion. No volunteer battalion should, I conceive, be allowed a place in a field brigade which does not come up to a certain standard of efficiency. Volunteer corps which, for want of opportunity or other causes, do not attain this standard, to be allotted with the pensioner force for the defence of fortresses, &c.

I trust I have now sufficiently explained the measures proposed for the organization of our infantry forces and our home reserves, so as to meet the propositions set before you. I have not proposed any new establishment, and although, for purposes of organization and inspection, I have proposed an addition to the number of brigades, the brigade staff may be formed by a redistribution of staff appointments.

In reference to our self-governing colonies, I have indicated (page 318) the arrangements which I propose for *training* the local reserves, their organization would be carried out on the same principle as that of the home Army, subject to modifications to meet local requirements.

In regard to the third head under which the subject of army organization has to be considered, viz., the Administrative Organization, I would, for my individual opinion, refer to the evidence which I gave before Lord Strathnairn's Committee, in 1866, page 140 of Blue Book. I then advocated the amalgamation of the Military Staff Departments, under one head, and of the Supply and Transport Departments under another.

In the field, the first of these Officers would be at the General's side to carry out his orders in respect of the movements and disposition of the combatant troops in front. The other would be charged with the equally important staff duty of bringing up the supplies from the rear.

In a garrison or military district these two staff Officers, with the

Officer commanding the Royal Artillery, being the Officer in charge of armaments, and the Commanding Royal Engineer being the Officer charged with defences and works, and a Financial Officer, who should be a civilian, would form a Council to which the General might appropriately have resort for advice on all important matters affecting his command.

I see no reason to alter the classification of duty which I then advocated, with this exception, that the civil element should not in any respect be an executive Officer, but that he should be one of the civil servants of the Crown, probably a selected clerk from the War Office or Treasury, and that his relations to the General should correspond with that of a Colonial Secretary to a Governor, with that of a clerk of a bench of magistrates to the Justices, or with that of the Assistant Under Secretary of State for War to the Secretary of State, viz., to advise the General on all matters of finance or regulation, and to carry on, under his instructions, correspondence on subjects of administration, and to issue warrants for expenditure authorized by the General under emergent circumstances without the previous sanction of the Secretary of State.

Under present regulations, when a military force is beyond the immediate control of the Secretary of State for War, the General is his representative, and it would appear to be inconsistent with that theory to give to any subordinate Officer a position or power which would imply a control independent of the General, and this would be the more objectionable in principle if the controlling Officer had to direct executive business involving the local expenditure of public money.

The suggestion I make would not involve the creation of new high appointments, and the administrative capabilities of the civil servants would be increased by their temporary employment in the capacity of Secretaries to the Generals in command of stations.

The subject of administrative organization is, however, now under consideration, and is not one on which it is proposed to invite discussion.

The CHAIRMAN.—We have to thank Major Leahy for having laid before us a very comprehensive scheme, which, as you have heard embraces a large number of subjects both of principle and of detail. The subject is a very large one; and Major Leahy has treated it with very great ability, and in a very comprehensive manner. Perhaps, the best course that we can now pursue will be, that if any points in the paper are not quite understood, and more explanation is required, gentlemen should question Major Leahy, in order that he may more fully explain them. I am rather inclined to doubt from the large area which the paper embraces, whether it can be discussed very easily without being first in print, and read by those who wish to discuss it. The paper is extremely well put together, but, as I have said, it embraces so much detail, that if I attempted to discuss it, I think I should have some difficulty in knowing how to handle some of the points, without a little more study than can be given to them upon hearing them the first time. As far as I am personally concerned, I am not prepared to enter into any discussion, or to express any opinion upon it at the present moment. Probably I should not be prepared to express any very strong opinion upon it at all, on account of the position I have the honour to hold. For whatever I might say, though it might only be in discussion,

might carry with it more weight than it might deserve, and be received as an authoritative scheme, when it would be only the opinion of an individual. I make these few remarks for the purpose of suggesting to the meeting that, as far as the discussion is concerned, we should take another day for it; but I think there are many points upon which members might wish to be further enlightened, and upon which they might now put questions to Major Leahy.

Colonel ALCOCK, Commandant 1st Regiment Middlesex Militia.—It may appear very presumptuous in me to venture to offer an opinion upon so comprehensive a paper, and one so ably written as that which we have just heard. But, perhaps, as you, Sir, have already suggested, it might be possible on a matter of detail to mention something that may be of interest to the meeting. The point of detail which I would select, is one applicable to that part of the service to which I belong, viz., the Militia. It happens to be one in which I can, I think, to a very great extent corroborate the general principles which the lecturer has laid down. One principle is, that a Regiment of Militia should consist of two battalions; another is, that the industrial employments of the men who form the Reserve, should not be interfered with. The Lecturer compared our organization in that respect with the organization of the Prussian service; but it would be more appropriate, as it seems to me, to compare it with that of the French. A good deal has appeared in the papers lately, and everybody knows, that the organization of both the French and English services has a certain similarity, inasmuch as in both, there is an active Army, and a Reserve, consisting of old and young soldiers, and a second reserve, consisting in the French, of the *Garde Mobile*, and in the English, of the Militia, the Rifle Volunteers, and the Pensioners. The French organization is strong, because it is based upon the conscription. The English organization is weak, because it is not based upon the Militia, which is the old constitutional Army of the nation. Now, what I wish to point out is—not that I am so well prepared, perhaps, as I ought to be to speak upon the subject,—but I think I can show distinctly that the view which the Lecturer has taken is perfectly sound, and applies most particularly to the Militia Service. The Militia, as we all know, is called out for twenty-eight days' service in the year. It consists of men who can give twenty-eight consecutive days from their employment; therefore, it includes that class only, and no other. If you wish to increase your members, you must include a larger class. The gallant Officer has said that the industrial employments of the men should not be interfered with. And here we come to the rule, that when you want a larger number of men, you must consider the relation which the pay and the period of military service bear to the wages and the demands of civil employment. You must consider both, or else you cannot get the men. The Militia are expected in times of emergency, in times of war, to supply the line with drilled men, and at the same time to keep up their own establishments; two things, which we know from our experience in the Crimean War, are almost impossible. It was done, but only with great difficulty. Under the present system of warfare, it would be still more difficult, because things must be done much faster than they were formerly. To succeed, we must depend entirely upon organization, and not upon money. The idea seems to be prevalent that, being a very wealthy country, if it comes to a push, we could, by trusting to the pluck of our men, and to a lavish expenditure of money, accomplish anything. It is my firm conviction that this is a mistake, and that we must trust to organization. That remark brings me back to the subject of organization. For the Militia to supply the line with trained men, and to keep up their own establishments, they require themselves to have a Reserve. Consequently, instead of our organization being similar to that of the French Army, namely,—

Active Army,
Reserve of old and young soldiers, mixed,
National Guard Mobile,

the English ought to have been as follows :—

Active Army and Army Reserve,
Militia and Militia Reserve,
Rifle Volunteers and levy *en masse*.

The effect of having a Militia Reserve would be this; that those men who are unable

to give 28 consecutive days' training, whose civil employments would prevent their doing so, would be in the Militia Reserve. Of course, anybody may say: but how would you manage all this? I can assure you that the thing is so simple, that it is wonderful beyond measure that it has never been adopted. The fact is, that we are actually training and selecting men whom we are unable to keep, because militia regiments cannot have in their ranks, men who cannot give those 28 consecutive days' training, and well drilled and equipped men, of excellent character, are obliged to leave the militia, and this at the very time when there is some talk of an increased capitation tax in order to increase the number of the rifle volunteers. I should not like to speak in excess of the number, as it is impossible to know very accurately, but upon an average from 30 to 40 well-trained men, of excellent character, fully equipped, leave the militia regiments every year, merely because they cannot give 28 consecutive days to training with their regiments. The state of the case is simple enough. If you want to retain these well drilled men, many of whom would gladly serve in their regiments if embodied, your plan would simply be to put them into the "Militia Reserve." If you ask me how the Militia Reserve is to be managed, I say, manage it in the same way as the Rifle Volunteers are managed; you are doing all you can to increase the Rifle Volunteers. I say give us a Militia Reserve in every respect the same as the Rifle Volunteers; deal with the men as you do with the Rifle Volunteers. Let men be attested for either the Militia or the Militia Reserve, and let those whose masters will not allow them to serve 28 days, go into the Militia Reserve. I think I collected from what the gallant Officer said, that the Staffs are expensive, and that it might be a question whether the Staffs could not be reduced. I think it would be much better policy, not to reduce the Staffs, but to increase the amount of benefit which the country should receive from their services. You have got excellent Adjutants and excellent Staffs, make them also the staff of the Militia Reserve. There is likewise some talk about the want of promotion in the Militia; that difficulty might be easily overcome. Only let some efficient lieutenant who resides upon the spot, undertake to form a company, and when he has got a company for the Reserve then let him have his promotion. By this means you would increase the chances of promotion. Without going further into the subject, I can assure you that if any one will consider it thoroughly, he will see that there is great truth in the view I have put before you, that the efficiency of our Army, both for internal and external action, would be much greater with that simple alteration which I propose. It is an extraordinary thing that we actually have the men, but we do not keep them; all I propose is that they should be kept. If the subject were to be examined, it would be found that I am right in what I have said. It would entail no expense whatever, although I am far from advocating that expense should not be incurred when necessary; the country is rapidly increasing in wealth, and the cost incurred in organizing for its defence, is the insurance we pay on our national wealth, which has been increasing at the rate of £120,000,000 per annum, while our rate of insurance is not increasing at all. No one can foretell what may happen, no one can forecast political or commercial events, and should any eventuality arise, our Army Organization ought to be commensurate with the magnitude of the interests at stake.

The CHAIRMAN: I would remind the meeting that Major Edwards' paper is also before it. Everybody is cognisant of it, and in any remarks made upon that paper, in combination with that of Major Leahy's, I hope that the whole subject will be dealt with.

Captain J. B. ROBINSON, Northamptonshire Militia: Perhaps I may be allowed to say a few words, principally in support of what the last speaker has said with regard to the Militia. I think we have been very much misled by the use of the word "Reserve," in fact we have no Reserve properly so-called; we have no Army Reserve that can be moved out of the country. We have merely got a local Militia, in the old sense of the term, and the Volunteers. Colonel Alcock stated that Militia regiments did volunteer to serve in the Crimea. That was done under a special Act of Parliament, and it would require another Act of Parliament to enable them to volunteer for foreign service at the present time. Before any reform in the auxiliary services of the Army can be made, it should be known what we want. There is confusion in our ideas as to the Militia. Some officers look upon the Militia as a service

that is merely a nursery for the line, while Militia Officers probably look upon the Militia as a Service in itself, which is to be kept intact, and in the finest working order possible. No one can blame the Militia officer for being jealous for the efficiency of his own *corps*. Until we arrive at some idea of what we want—whether the Militia is to be simply a nursery for the line, or whether it is to be a local force ready to garrison England, and so far to act as a reserve to support the regular Army by service at home in garrison duty—we shall never come to any satisfactory decision. The Militiamen, as to rank and file, I believe to be of very good stuff indeed, but many of the Militia Officers are men who have had no opportunity of learning their duties. The Officer is called out for 28 days; he finds half the regiment, or one-third of the regiment consists of recruits, and the others, men who were well drilled a year ago, but who have, perhaps, half forgotten their duties. The sergeant-major and the adjutant, naturally and properly, think more of forming the men than of forming the officers. Unless the officers have an opportunity of being attached to regiments of the line, and thus learning their duties, we shall never have them efficient, and we shall never get an efficient regiment.

Major LEAHY: With reference to a Militia reserve, it must be borne in mind that the militia consists at present of 120,000 men, with power to raise it in time of war to 180,000 men. These additional 60,000 men might be enrolled in a Militia Reserve. There is a further power to enrol and train 200,000 men under the Act of 1806.

Colonel ALCOCK: The authority does not exist for having any Militiaman if he cannot serve the 28 days. After the man's period of service has expired, he retires, if it has interfered with his civil employment, and if during the five years of his engagement as a militiaman he gets a good situation, he is entitled to leave the service upon paying 18*s*. 6*d*. My view is that such well drilled men ought not to be allowed to leave, but ought to fall back into the Reserve, and be treated like Rifle Volunteers.

The CHAIRMAN: The great object, as I understand, of the two papers laid before you is "Organization." There is no doubt that what the gallant officer, Colonel Alcock, has brought before you, is most worthy of consideration; it is a most important part of the subject. There is no doubt whatever that the militia are under considerable difficulties: in the first place from being called out at particular periods of the year for 28 days, people have to leave their industrial occupations, and consequently are often obliged to give up their militia service rather than lose their industrial employment; and, in the second place, there is also a great difficulty with regard to the officers. We have heard a good deal of "the county connection." The "county connection" has been hitherto a most important element in the militia, but I am afraid that those who study the Army List and look at the requirements of the Militia, will find that that service at the present moment is not quite so popular a service as it should be, with those who live in the different counties. The militia is very short of officers, very short of subalterns, and in some instances, I am afraid, very short of captains. As I said before, however, the great problem brought, first by Major Edwards, and secondly by Major Leahy, before this Institution, is a system of "organization" which shall make our forces more useful both in time of peace and in time of war. At the present moment I am not quite prepared to say in what particulars the difference between the two papers consists. Major Leahy distinctly goes in for two battalions, a battalion for home and a battalion for Indian or Colonial service. I think Major Edwards divides his into three classes, [Major EDWARDS: As regards the reserves I make no change whatever.] and in another form of organization that they should be "divisionized" in different parts of the country; that the militia should be occasionally formed up with the line, and that there should be a system of brigades and divisions in different parts of the country. That I understand to be part of the system which is advocated, a system which is obviously necessary to make our forces more efficient, to bring the staff into greater play, to have the duties more adequately performed, and also what is still more important, to enable those in charge of certain portions of the country to know exactly what the resources of those parts are, supposing the troops were suddenly called out. Those, as far as I can understand, are the chief features of the subject brought before us. The two papers certainly require very minute study for the purpose of thoroughly com-

prehending what are the different objects proposed by the two lecturers, and for the purpose of bringing a useful discussion to bear, with the view of seeing what would be the best system of army organization for the country.

Major Edwards: We are going, I think, rather too much into detail, and keeping away from the general principles which I tried to establish. Perhaps, as some of the members present may not have read my paper, I may mention two or three points in it. The principles are :—

1st. To concentrate the army to a greater extent in the United Kingdom.

2nd. To divide it into *corps d'armée* of equal strength, and distribute it with reference to them.

3rd. To organize the militia and yeomanry, so that they can readily join the regular *corps d'armée*.

4th. To give to the field artillery an organization which will render it capable of rapid expansion.

5th. To form depôts for the establishment and instruction of a reserve of trained men for the different services.

Anybody who considers the want of organization in our Army at the present moment, can, I think, only come to the conclusion, that these are the *five principal steps* that are necessary for putting us in a position to turn out all our forces in the shortest possible time, either for the defence of the country, or for the despatching of expeditionary corps to different parts of the world. To divide our Army into *corps d'armée* of equal strength, is, I think the most important step. The administrative units of an Army vary according to different circumstances, and may be as in ours, a battalion of infantry, a regiment of cavalry, or a battery of artillery. But the tactical unit of an Army is the same for all modern Armies, or nearly so; it is generally called the *corps d'armée*. It is composed of all arms of the Service, infantry, cavalry, artillery, engineers, military train, in proper proportion to one another. Now, if these tactical units are not organized in time of peace, it is impossible that an Army can be effective in time of war. This I hold to be a most important point in considering the organization of an Army. Because if you are suddenly called upon for defensive warfare in this country, or warfare abroad, and your tactical units are not kept up in time of peace, you cannot create them in time of war. This happened to a certain extent in the Crimean war. We sent out that expedition by battalions of infantry, regiments of cavalry, and batteries of artillery, and all the odds and ends of the Service. First of all, we occupied Malta, where these forces were formed into brigades and divisions. Then they were pushed up further to the front. Our present system obliges us to occupy some safe spot outside the enemy's frontier in order to form our Army, before we are in a position to use it for hostile purposes. If we do not form our Army to a certain extent in this country, it is quite impossible, when war breaks out that we can despatch an expedition abroad, perfect, complete, and ready to undertake such hostile operations as its strength will allow of. Therefore I hold that it is absolutely and indispensably necessary that the tactical units of our Army must be maintained in time of peace.

In talking of the Militia and Volunteers, the subject, generally, is not considered in a comprehensive spirit. People generally run off into "Reserves" without knowing that the whole of the Reserve forces must be capable of being fused together into one mass at a moment's notice for use. It is no use your having an indefinite number of battalions of Militia, Volunteers, and regular troops, unless you have all the different arms of the Service tolerably proportioned to one another. For that reason it is absolutely necessary to organize the militia and yeomanry, so that they can easily join the regular *corps d'armée*.

The great object in view, is to be able at once to place the regular Army of this country on a war footing, ready to commence a campaign at once; so that the War Minister, from his office in London, with the Commander-in-Chief, could, in two or three days, bring forth all our defensive power. At the present moment I need hardly tell you what a state we should be in, if this country were really invaded. If a thoroughly organized Army of 80,000 men were to land on our shores, we should find it very difficult to make any show against it. If the country were threatened with invasion, we should call out our Militia, Yeomanry, and Volunteers. But

before they could become of any use, they would have to receive an Organization corresponding to that of a regular Army. The present regular Army would become the nucleus for the formation of *corps d'armée*.

Colonel ALCOCK: I should like to ask, whether I understood rightly, that each regiment of militia was to have a second battalion?

Major EDWARDS: Yes, each regiment of militia. There are 135 regiments at the present moment. Instead of that, I would have 60 regiments of three battalions.

Colonel ALCOCK: So I collected. As the object which you wish to obtain is the mobilization of the militia, it depends upon minute details. I should like to state that it is essential that each particular Militia Regiment should have its Reserve. The reason is very obvious, and it would carry the more weight, because it would be a direct saving to the country. It would be a saving to the country in two respects. In the first place, the country would get more for its money; and in the next, in the event of war—everybody who has any knowledge of what occurred during the Crimean War will know this—that when a militia regiment was embodied, and became equivalent to a regiment of the line, the wives and children of the married men being left behind, became a very heavy charge upon the State. If there had been a Militia Reserve regiment, as there ought to have been, the married men would have been transferred to the reserve, and the single men would have gone from the reserve into the regular army.

Major EDWARDS: That point I meet by having each regiment to consist of three battalions. The first battalion would consist of men who would serve and undergo a considerable amount of training. If you take three regiments as they are now, three county regiments, and fuse them into one regiment of three battalions each, the first battalion will consist of men who will undergo more efficient training, and who will be ready at a few days' notice to join the regular Army; the second battalion will be available to undertake garrison duty—they would not require the training of the first battalion, and that meets the question of keeping the men who could not afford to give up twenty-eight days to training; the third battalion would be the reserve, who would answer all the purposes which Colonel Alcock has suggested.

Colonel ALCOCK: I admit that the theory is perfect, but I must be excused for saying that I doubt its efficacy in practice. The present system, as it is, is perfect, if you would only use it; leave the regiments as they are, and give them a reserve, and you will have them ready to bring out at a moment's notice. At this very moment we are discharging men from many regiments at the rate of forty men in the year, well-trained men: those are the men I want to put into the reserve.

Captain ROBINSON: With regard to putting the married men into the Reserve, I know one village in the midland counties, where all the married men volunteered for service in the Mediterranean, and all the unmarried men joined the depôt.

The CHAIRMAN: I think we have laid the foundation to-night for a good discussion. The two papers should be read attentively by all who wish to take part in the discussion, I trust that when we meet again, we may have a good discussion upon the merits of the proposed systems of organization. There are many points, no doubt, of detail, as you have just now heard; but they are, if anything, points for the office—one might almost say,—rather than for a discussion on the broad question. The question before us is organization upon a great scale, and our discussion should be mainly upon that. If it is agreeable to all, we will adjourn to Thursday week. I conclude by saying that you will permit me to express the thanks of the meeting to Major Leahy, as well as to Major Edwards for the papers which they have laid before us. They will be most useful I am sure to the Service.

The meeting was then adjourned to Thursday, May 7th.

Thursday Evening, May 7th, 1868.

ADJOURNED DISCUSSION ON "AN ORGANIZATION FOR THE ARMY OF ENGLAND."

COLONEL THE RIGHT HON. THE EARL OF LONGFORD, K.C.B., in the Chair.

The CHAIRMAN: The discussion this evening is a continuation of that which commenced here a few evenings ago on papers read by Major Edwards and by Major Leahy, R.E. I take the chair under some disadvantage, from not having been present on the former occasion. I am, therefore, rather in a position to listen than to take any part in the discussion. I have been requested by the Council to state that the points which are embraced in these papers are of sufficient importance in themselves to occupy our attention this evening; but there are various other points of military interest which will be postponed for separate discussion on a subsequent occasion. I invite gentlemen to make remarks upon the following propositions which have been laid down. Moreover I trust, that they will confine themselves to these points.

MAJOR EDWARDS' PAPER.

Propositions—

1. To concentrate the Army to a greater extent in the United Kingdom.
2. To divide it into *corps d'armée* of equal strength, and distribute it with reference to them.
3. To organize the Militia and Yeomanry, so that they can readily join the regular *corps d'armée*.
4. To give to the field artillery an organization which will render it capable of rapid expansion.
5. To form depôts for the establishment and instruction of a Reserve of trained men for the different services.

MAJOR LEAHY'S PAPER.

Propositions—

1. That in order to increase the means of organizing Army corps, each regiment should consist of two or more battalions, one for home service, the other for colonial service; and that a proportion of the Army Reserve force should be attached to the *home battalions* sufficient to make up *both* battalions to the war establishment.
2. One or more divisions of regular forces to be quartered in each military district, to form the nucleus of an Army corps with *staff complete*. Supervision of all enrolled auxiliary forces to be intrusted to General Officers of districts and their brigadiers.
3. Portion of the regular and auxiliary forces in each district to be annually encamped and formed into brigades, and manœuvred with due proportion of cavalry, artillery, engineers, and train.
4. The foregoing propositions will not involve new legislation, or radical re-organization of the Militia.

Major-General BOILEAU, R.E., F.R.S.: It was hardly my intention to take part in this discussion, because the subject is one of so purely a military character, and belongs more properly to those who have served with armies in the field, that I feel great diffidence even in expressing any opinion upon it. In order, however, to break the ice, and to prepare the way for those who are better qualified than I am, I will make a few observations upon one or two points contained in this schedule. With regard

to the concentration of the army, I think that Major Edwards' paper embraces all that is necessary to be brought forward in a general point of view. With reference to the division of the forces into *corps d'armée* of equal strength, and their distribution, the proposal is one in which I believe most persons will be inclined to agree with Major Edwards. There are one or two points with reference to details which in reading over the paper, have struck me. One is with regard to the military train. The number of men included in each *corps d'armée* appears to me to be insufficient for general purposes. The number in the Prussian Army, which has lately shown itself in the field to be excellent in all its details, is about three and a half times the strength of the military train proposed here. But if, by the expression "military train," I am to understand that it is to consist of wheel carriages drawn by horses, I must say that, however much such a system might apply to countries where roads are in existence, or where they can be made as required, there is no doubt that wheel carriages, with horses to draw them, form an excellent military train. But there are other countries where trains of that kind would, in my opinion, be inapplicable; therefore, for that portion of the Army which Major Edwards proposes to keep in India, I do not think a military train composed exclusively of wheel carriages drawn by horses would be applicable. Those who have served in India will remember that, for the carriage of camp equipage and of a large portion of the baggage, the military train consisted entirely of camels. The camel is an animal that has not been inappropriately called the ship of the desert. Its services may be made available in many ways. For instance, camels can be applied to guns; they can be applied to carriages; they can also be applied to the carriage of baggage of all descriptions, if not very large and heavy; and they can be used in transporting troops rapidly from one place to another. Therefore, I think, in all military trains which are to be organised in India, camels should form a very large portion of that train. With regard to the Abyssinian expedition, and what has fallen from the talented author of the first paper upon that subject, I do not think that a military train would have suited the requirements of such an expedition. There were no roads even from the sea-side, and pack animals had to be used there. Approving, as I do entirely, so far as I am able to judge, of the system here proposed, I think there should be some reservation made with respect to the military train, especially for service in India, and also in such countries as Abyssinia, where you require a special organization for each. The next point is one which relates to the organization of the militia and yeomanry, so that they can readily join a *corps d'armée*. That is a question upon which I forbear speaking; also with regard to the organization of the artillery, which is a question for artillerists, not engineers. With regard to depôts, I think the system proposed is an excellent one. I would observe, however, with all deference to the author of this paper, that for the instruction of engineer soldiers and recruits, depôt companies are not sufficient. You require scientific instruction in the Engineers as well as in the Artillery; therefore the troops should be organized and instructed at fixed establishments, and in larger numbers than can be brought together in depôt companies. Those are questions of detail. As far as I have been able to study the paper, and to understand its details, I do think it forms a very excellent groundwork for future action, by those in whose hands will rest the organization of our forces. The idea that we should supplement our regular forces by reserves of militia and yeomanry is a very good one; and the project which purposes to give us an Army of 160,000 men instead of 80,000 appears to me to be within the practicability of our present establishment. The only other point which I would wish to refer to is that of using native troops in hot countries to assist Europeans. I think the suggestion is a very good one. It is not altogether new, but the view which Major Edwards takes of it—that of supplementing the service of Europeans by that of natives—is, in my opinion, one which is very sound, and which would lead to the most useful results. I have not had time to study Major Leahy's paper, which contains more statistics than this does. The observations I have offered to the meeting were merely intended to lead the way for others of more matured and greater experience, to give their opinions. Having done this, I trust that others will continue the discussion, and favour us with their views upon this most interesting subject.

Major Sir HARRY VERNEY, Bart., M.P.: Having been called on to say a few words upon this most important and most interesting subject, I feel that I do so under greater disadvantage than many Officers present, who have given their minds to this matter, and particularly those who had the advantage of having heard those papers read on which I understand the discussion is now to be taken. Certainly, it is a subject which has always peculiarly interested me from my very boyhood; because I recollect as a boy going with my father to the different points in the south of England where it was proposed to concentrate troops at the time that the French army was concentrated at Boulogne, and we had reason to expect an invasion. I recollect going with him along the different lines of hill on the south coast of England, and his showing me the different points that were to be taken up, and the towns and villages where the magistrates and others had orders to collect depôts, and to take all precautions for the defence of the country. I recollect a little old man coming into my father's room at the Horse Guards one day, and saying, "Sir, I "have got 80 waggons, with 8 horses each, and drivers, which are at the disposal "of the Government to go at any moment to any part of the country where "they are wanted." Some of the older gentlemen present will recollect "Russell's flying waggons." It appears to me that the important thing for us to consider is, what would really happen in case this country were threatened with invasion? I believe that there would be an endeavour to collect hostile fleets at several different points on the coasts opposite to our own; that we should be threatened not with one invasion, but with several invasions. I imagine nothing would be easier, should we ever go to war with France, than for several corps of the French Army to be collected, who would be ready to throw themselves *perdus* upon our coast; every man of them would be perfectly satisfied though he expected never to return. Now, there is the danger we have to look in the face. Do not let us think that it will be anything less than that. There would be several *corps d'armée*—four, five, or six—prepared on the opposite coasts to throw themselves upon different points of the coast of England; and if two out of these could effect a landing they would be satisfied with their success. We all know that in foggy or bad weather there is nothing to prevent an Army landing anywhere, particularly when we have seen how rapidly armies may be embarked. Who will say that if five or six different bodies of the enemy were prepared to cross, two or three of them would not succeed in effecting a landing? That is the danger which I believe we have to provide against. Of course the existence of railways would be of very great importance in resisting any such attack. Sir Willoughby Gordon made a very true observation when he was asked, "What is the inconvenience of diversity "of gauge?" "I think the inconvenience would be that of a ferry; if you have to "change all your material of war and troops from a railway of one gauge to "a railway of another gauge; it would entail a very inconvenient operation, "and cause serious delay." I hope, indeed I suppose it cannot be doubted, that those in authority have made their preparations, and have mapped out the country in a way which has been decided upon after the consideration of how an attack of this sort could be resisted. It has always appeared to me a matter of great importance that those who would be the first to throw themselves on any point of danger—I mean our Volunteers and Militia—should have their efforts wisely directed. What I should be afraid of, in any event of this sort happening, would be that they would expose themselves injudiciously, and our best and most valuable men be shot down and destroyed. Therefore, means should be taken before-hand to enable the Militia and the Volunteers to act with the regular Army. Moreover, if a staff could be formed, so that it would not be necessary to take away the staff from the regular Army force, where in time of war it would be wanted, if a staff could be provided from these Reserved Forces themselves, I think that would conduce very much to the efficiency of the Volunteers and Militia. There are other points which have suggested themselves to my mind also, but this is not the time for discussing them. This is not the proper time for discussing, for instance, the soldier's period of service in the Army. But it must be evident to every one that it is the system of "short service" in the Prussian Army which enables large forces to exist in that country. The real success of Prussia at this moment is due to General Scharnhorst, who, after the battle of Jena, when Napoleon said, "You shall only

"have 42,000 men in the Prussian army," took care to change the 42,000 men every five years; so that when the time of war came, Prussia had a large Army ready to take the field. This is not the time, however, to discuss that question, but I trust that it will not be overlooked by those who have the management of the Army.

A MEMBER: Am I to understand the honourable gentleman who has just sat down to say that he considers the conscription desirable in this country, as they have it in Prussia? I do not see how we can do without it.

Sir HARRY VERNEY: I think every man in this country is bound to be ready to serve his country when danger is at hand.

Colonel EWART, R.E.: I think, my Lord, that the papers before us present so many subjects for discussion, that the principal difficulty for those who attempt to enter upon the question would be to confine themselves to the particular points that we have to discuss. For myself I have followed the last speaker along the south coast of England, although far more recently. I have studied the different preparations which were made at the time of danger in order to provide against invasion, and I must say, from what I saw, considering the circumstances of that time and the difficulties of communication, that they were very perfect. In the present day we are under far greater advantages, because we have such ample railway communication. We have opportunities of rapidly sending forces from one part of the country to another. But what we want is, to picture to ourselves what may happen and what would be required. In considering these papers, I must say I think, considering the requirements of our Army, that the organization by *divisions* is more possible than the organization by *corps*. We may say that in Ireland we have about a *corps*, but in England I think it very difficult to establish a *corps* organization. With the requirements of our colonial duty, with the requirements of India, with the various expeditions which we have to fit out for foreign service, all these expeditions being under different circumstances, I think that the working by *corps* would practically be found next to impossible. The system of working by divisions, which was adopted in this country to a large extent after the experience of the Crimean war, appears to me to be one which is very possible, and which may even be carried out to a greater degree than it is at present. The principal thing that we want in the divisions is more of the administrative element. We have plenty of the moral element; we have got an efficient staff, and, thanks to the Staff College, experience in late wars; we have a considerable reserve of Staff Officers, who could be readily called out if they were required. There is another point in Major Edwards' paper which he dwells upon, which is that of reducing our forces very considerably abroad, in order to have more at home, and largely employing native troops. That subject has been lately very carefully considered by a Parliamentary Committee. Having taken great interest in the subject, I have looked at their conclusions, and I must say they come very much to what I have always thought. It appears to me that in some of the colonies, such as the Mauritius, China, and Ceylon, native troops to a certain extent may be employed with great advantage. But there is that difficulty, that if you move troops from India to those colonies under the circumstances of the Indian Army, you have forces with Officers at a high rate of pay doing duty with British Officers of the ordinary English Army; and then, immediately, arises the difficulty of these Officers being paid upon different scales. Therefore, if you adopt this system, you must do it very much by raising a force for employment in those colonies, and instead of the colonies contributing as they do at present a certain sum which is carried to their credit, possibly the colonies might directly pay those troops. With regard to the remarks in the paper of Major Edwards' upon the Abyssinian expedition, it appears to me that to have sent, as he suggested, a *corps* direct from any place to carry out that expedition would not have been so successful a plan as the one adopted, because it is a country that required an Army with a peculiar organization. You sent there the particular kind of troops required, and you formed up your Army with such troops as were most suitable for working in that country. For instance, in one country you require a large proportion of men who are able to work in a cold climate, and work in the hills. Under other circumstances you might have to employ troops that are more accustomed to work in the plains. With regard to what was said just now upon the subject of the military train, it appears to

But I conceive my lord, that in any question relating to the organization
, the Militia of England must always have a very important place;
regular Army is a very small one in proportion to those of our neighbours.
e of Volunteers is one, the action of which is as yet unknown; and really
ansive force which this country has to fall back upon, is the old Militia
country. It has still the advantage of being a force which can be
llot at any moment, and which, therefore, may be increased very largely
ed. Some gentlemen who have already spoken have treated the subject
times of peace; but I think the most important bearing of this subject
hich relates to a time of war, when the utmost energies of the country
forth. It is in that case that the Militia will be called to aid the regular
ill become the real Reserve. In relation to this, I find, that in speaking
ia, it has always been considered as a feeder, that its principal function
to be that of a feeder to the regular Army. No doubt that is a
nt function. But I should like to place before this meeting another
nportance. If the regular forces of England are sufficient to meet the
a great war, by all means allow all our auxiliary forces to act merely as
if at any moment our whole regular Army were very much engaged and
h abroad and at home, we must look to an organization at home which
ements of self-reliance. I therefore think that in dealing with this
ght be kept in view that our militia should be so treated, that it would
act, not only with, but independently of the regular Army. The
ho spoke a short time ago said he believed, and a great many coincided
that belief, that the reserved forces ought to lean still more upon the
ll their operations. So far I quite agree with that remark. I think they
o trained and so organized, that they should always have the Regulars as
nd be able to act with them. But I do not think that they would be a less
port to the Regulars if their organization were of a character to develop
rces. This leads me to the few suggestions which I should like to make
the Militia, in order to make it a Service upon which the country might
y than it does at present, and which would give it that self-respect and
eeling which I am afraid is wanting in it to a great extent at the present
as I can gather from the conversation of those who speak upon this
that, if the Militia perform their functions in barracks, march past well,
ppearance and look like Regulars, that is all that is required of them.
re, in order to make our Militia useful to the country, and a force to be
it the great object should be to have its Officers educated in such an
er as that they shall feel themselves qualified, and shall be actually
ke the new levies and train them, however largely they may be increased
and also to perform for themselves temporarily, those staff duties,
nized Militia would require. I think the omission of this is the great
litia training, as it at present exists. The question is, what is effici-
iency consists in collecting a certain number of men at the county
for one month in the year, and making by any means, and by the
the greatest exertions, those men look smart, drill well, and so on,
Militia performs its duty very well. But at the same time, I believe
uld be a far more important auxiliary force if it received some organi-
would make it consistent as a whole. For instance, if the country
to military districts, the head-quarters of each being supplied with
er of the regular staff of the Militia, and these head-quarters were
whole of the drill season as a school for some Officers and men, I
n in saying that the Officers of the Militia would gladly avail them-
rtunity of learning their professional duties there. I have heard that
men, who form the largest class in the Militia, would grudge the
attention required to qualify themselves for their duties. But I
y contradict that statement. I have always noticed that the best
are those who are most ready to learn their profession. I should be
the false position which the Militia officer is in at present, could
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Major Leahy and the gallant Officer who has just spoken have arrived at. I find in Major Leahy's paper that he proposes, that each regiment should consist of two or more battalions, one for colonial service, another for home service; and that a proportion of the Army of Reserve should be associated with it. It has always appeared to me that an organization in two or three battalions—I think myself three battalions—would be particularly suited to the circumstances of our Army. I also think it would be a very great advantage if, say one battalion of Militia could be connected with this force of three line battalions. I am aware there would be great difficulties in carrying out such a composition. You would require to reduce some regiments and to amalgamate others. Of course, there is the great objection that Officers would have to move about from one battalion to another, which some Officers might think would tend to destroy that *esprit de corps* which has always been considered a very strong point in our system. However, we find in the Guards, we find in the 60th Rifles, and in the Rifle Brigade, to say nothing of the regiments which have recently been increased to two battalions, that this effect is not produced. We find that these regiments are organized in two or three battalions, and that the Officers shift from one to another, and that nevertheless an *esprit de corps* exists in them, quite as distinct and quite as strong as that which exists in any single battalion regiment. The *esprit de corps* in the 60th Rifles, for instance, is not different in kind, or in degree from that which exists in any distinguished single battalion regiment, say the 42nd Highlanders, or the 52nd Light Infantry, therefore, I do not think that would be a valid objection. With respect to recruiting, there might be some difficulty. My idea is—I do not know if worked out in figures how far it would suit—but my idea is that you might have two terms of enlistment. I would enlist men first of all for a sort of Militia service: two years at the depôt, and ten years as the Militia now are, disembodied, but liable to be called upon for a certain period of training. Of course, men enlisting under that form of engagement would naturally receive a lower rate of pay, and perhaps no bounty; or, if any bounty, a lower rate of bounty than men who engage on terms similar to the present terms of engagement in the line regiments, namely, continuous military service for twelve years, taking their turn of colonial duties. Supposing such a thing were practicable, and you had a large body of men enlisted to serve on these terms, namely, serving at the depôt for two years, and then returning to their homes as the Militia do, then I think it would be easy from this body of men to find volunteers sufficient to man the number of battalions, whatever that number might be, that was requisite from time to time to furnish troops for our colonial duties. I have thought of the question principally with reference to peace; I have not thought much of it with reference to war, because, as the gentleman who spoke lately said, you can only provide for that contingency by conscription. I think as he thinks, that for raising the vast number of men that would be required to contend with a first-rate power such as France, there is only one way of doing it, and that is, by conscription. My observations only apply to the peace services of the country. I think it is very desirable that those who have to look into these matters should consider the propositions of Major Leahy, and having worked them out in detail, should see what their advantages and disadvantages are. My idea is, that we should have three battalions, one for home service, one for colonial service, and one for the Army of Reserve; and I think that a battalion of Militia might be associated with them; that would make four altogether. That is the only point I have thought of; perhaps I should not have spoken at all if I had not found that the opinion I had arrived at, without having any communication with them, coincided with the opinion of gentlemen who I have no doubt have thought the subject out much more carefully.

Captain Moncrieff, Edinburgh Militia Artillery: I wish to make one or two remarks in connection with this very important subject, but I shall not venture to speak upon any point except the one which relates to the Militia. I have the honour to belong to that service; I have been in it for thirteen years, and am tolerably well acquainted with the Militia in England, Ireland, and Scotland, in which countries I have served. It has often occurred to me that those gentlemen who write and speak upon the subject, take a view of the Militia, which is the natural point of view, certainly, for regular soldiers and men who make arms their profession to

take of it. But I conceive my lord, that in any question relating to the organization of the Army, the Militia of England must always have a very important place; because our regular Army is a very small one in proportion to those of our neighbours. The new force of Volunteers is one, the action of which is as yet unknown; and really the only expansive force which this country has to fall back upon, is the old Militia force of the country. It has still the advantage of being a force which can be raised by ballot at any moment, and which, therefore, may be increased very largely when required. Some gentlemen who have already spoken have treated the subject as relating to times of peace; but I think the most important bearing of this subject is the one which relates to a time of war, when the utmost energies of the country must be put forth. It is in that case that the Militia will be called to aid the regular forces, and will become the real Reserve. In relation to this, I find, that in speaking of the Militia, it has always been considered as a feeder, that its principal function is supposed to be that of a feeder to the regular Army. No doubt that is a very important function. But I should like to place before this meeting another view of its importance. If the regular forces of England are sufficient to meet the necessities of a great war, by all means allow all our auxiliary forces to act merely as feeders; but if at any moment our whole regular Army were very much engaged and taken up, both abroad and at home, we must look to an organization at home which has some elements of self-reliance. I therefore think that in dealing with this subject, it might be kept in view that our militia should be so treated, that it would be able to act, not only with, but independently of the regular Army. The gentleman who spoke a short time ago said he believed, and a great many coincided with him in that belief, that the reserved forces ought to lean still more upon the Regulars in all their operations. So far I quite agree with that remark. I think they ought to be so trained and so organized, that they should always have the Regulars as their model and be able to act with them. But I do not think that they would be a less powerful support to the Regulars if their organization were of a character to develop its own resources. This leads me to the few suggestions which I should like to make with regard to the Militia, in order to make it a Service upon which the country might more fully rely than it does at present, and which would give it that self-respect and professional feeling which I am afraid is wanting in it to a great extent at the present time. As far as I can gather from the conversation of those who speak upon this subject, I find that, if the Militia perform their functions in barracks, march past well, make a nice appearance and look like Regulars, that is all that is required of them. Now, I conceive, in order to make our Militia useful to the country, and a force to be relied on, that the great object should be to have its Officers educated in such an efficient manner as that they shall feel themselves qualified, and shall be actually qualified, to take the new levies and train them, however largely they may be increased in numbers, and also to perform for themselves temporarily, those staff duties, which an organized Militia would require. I think the omission of this is the great flaw in our Militia training, as it at present exists. The question is, what is efficiency? If efficiency consists in collecting a certain number of men at the county head-quarters for one month in the year, and making by any means, and by the best means and the greatest exertions, those men look smart, drill well, and so on, I believe the Militia performs its duty very well. But at the same time, I believe the Militia would be a far more important auxiliary force if it received some organization which would make it consistent as a whole. For instance, if the country were divided into military districts, the head-quarters of each being supplied with a certain number of the regular staff of the Militia, and these head-quarters were kept during the whole of the drill season as a school for some Officers and men, I have no hesitation in saying that the Officers of the Militia would gladly avail themselves of the opportunity of learning their professional duties there. I have heard that the county gentlemen, who form the largest class in the Militia, would grudge the time, labour, and attention required to qualify themselves for their duties. But I think I may safely contradict that statement. I have always noticed that the best men in the Militia are those who are most ready to learn their profession. I should be sorry to think that the false position which the Militia officer is in at present, could be tasteful to any one. A force whose Officers do not get an opportunity of learning

their duty, is not in a fit state to take the field against an enemy. Unless every rank, especially the highest, is able to perform its proper function, I believe any attempt to make a first-rate Militia, will fail. Therefore I should like to suggest that greater opportunities may be given to Militia Officers to learn the duties which devolve upon them when they are called out. I am sorry that being unaccustomed to speaking I am not able to convey my ideas to this meeting as I should wish, but I think that my suggestions are worthy of notice; and, perhaps, some one will gather from my few remarks what I desire to say, and will be able to follow them up.

Mr. Stirling Lacon: I have read this paper of Major Edwards', and I have marked the number of times that the phrase, "in the event of invasion," occurs. I deny the possibility of an invasion, but as this paper and the discussion, like our *Journal* will be read by foreigners—let any one make a calculation of the extent of flotilla that would be necessary to bring over 30,000 men with their artillery and equipment. Moreover, directly the ships have let go their hawsers from the quays, the base of operations will be gone. I do hope, therefore, if this discussion is adjourned, that some Naval Officer will attend and tell us what they think of the possibility of an invasion.

Commander Colomb, R.N.: Being the only Naval Officer present, though I have felt very strongly indeed upon the subject, when I listened to the remarks of Sir Harry Verney, yet I thought under the circumstances it would be clearly out of order to mention the wider question of the possibility of invasion, but as Mr. Lacon has adverted to that point, and called upon the Navy to speak for itself, I hope that I shall not be altogether out of order if I make one or two remarks touching upon that question of invasion. I have been surprised in reading Major Edwards' paper, and in listening to Major Leahy's, and the remarks which have followed during the discussion on these papers, to hear no reference whatever made to the belt of floating fortifications which surrounds the country. On the one hand I see the Continent of Europe, with—I am speaking off-hand—I suppose 100,000,000 or 150,000,000 of inhabitants, which might be leagued against England in the event of that floating belt of fortifications being destroyed. On the other hand, I see a little island, with 30,000,000 or 32,000,000 inhabitants, who are supposed, by an organization among themselves, to be able to resist these 150,000,000 of men which can be brought against them. I look upon it that the idea is simply absurd, viewed in that light, to suppose that you can, by an organization of the interior forces of England, resist such a power. Therefore, I feel strongly that when military men commence a discussion of this kind, they ought to take it at the commencement, upon a higher and a broader basis than it has been taken in the papers under discussion. The Defence Committee confined their attention exclusively to preventing the landing of an Army, and it seems to me that the organization of the Army of England, as far as resisting invasion goes, should also be confined exclusively to coast defence, where the arrangement of the troops in masses, with their proportions of artillery, infantry, and engineers, are out of place, as I take it. What you require to do in regulating the arrangement of the Army, as far as relates to the question of invasion, is simply this: we may suppose it possible that small bodies of troops may evade our floating guard, and make dashes upon certain points of the coast, and the means of concentration upon those points I take to be what is really the requirement of the Army, as far as it relates to resisting invasion. As to organization for the purpose of acting as an Army in the field, that, I think, can only be undertaken when we have settled that it is not only possible but probable that a foreign Army will land and act in the country. That is a possibility which it is simply a question of money to avoid altogether: you have simply to keep your floating fortifications up to a point which will prevent any large body crossing the channel, when you have done that, it seems to me that no further organization in England is necessary, and if you cannot do that, then, as I stated on commencing my remarks, we having four or five times, or more, population against us, and nothing to prevent them coming over in immense hordes upon the country, then I say your organization will not avail you in such a case.

Lieut-Col. Viscount Ranelagh: Sooner than that this discussion should flag, I should like to make a few remarks especially upon what has fallen from the gallant

officer who belongs to the Navy. I did not quite follow him; I did not quite understand whether he says as a naval man that an enemy can attack us from the other side of the Channel, whether it is France alone, or France and Prussia combined or not?

Captain COLOMB: No, certainly not.

Lord RANELAGH: Upon that point I differ from him. I think they can. In former years we know that to invade this country, the enemy were compelled to collect a very large force upon the opposite shores, whether it was at Boulogne, or Dunkirk, or Brest, at all events we were made thoroughly acquainted with their intentions, and we had a long time to prepare for them. I take it now that steam and railways have completely changed all this, and that we are living under different circumstances altogether. As far back as the year 1848, I wrote upon the subject, and I challenged the critics of the day by saying that you can invade this country from Paris. And I say, again, that it is much easier now than it was then. If we are obliged to have resort to other than wooden walls, I would ask the gallant Officer how with our present means we should be able to blockade every port on the opposite coast from Dunkirk down to Brest, and whether, with the intelligence that there is in France, and the powerful means of organization throughout their whole system, they could not by a combined movement come out of five or six of those ports at certain times? We cannot blockade all those ports at all times. Can you prevent those forces coming out? I say you cannot, and it would require great vigilance when they were once out, to know what their point of landing would be. Those are my impressions. There may be gentlemen present who will take up that point and say whether I am right or wrong. I again say that, if necessary, the basis of operations might now be Paris, not Boulogne, such are the facilities that railways give. With regard to the Militia, I am not come here prepared to go into the details of both these papers, for, unfortunately, I have only read one of them, but I have always had a strong feeling that every attention should be given to the strengthening of that great national force. I know no force that requires all our best wishes more than the Militia. Of course there are various notions abroad as to how to carry that out. I am not going into details to-night, but in some evidence that I had to give before the Commission some five or six years ago, I then adopted a plan, which I do not think I have any reason to find fault with or to change now. I was asked by the Committee what my notions of the Militia were. I said I would be glad to add my testimony to the estimation in which that force was held. Admitting for the moment that the permanent Militia ought to be 150,000—I believe it is now 130,000, but you might have 150,000 without any difficulty—I would put on the ballot. The word "ballot" is a very disagreeable word, a word that frightens most people, but I would not put on the ballot in the sense that most gentlemen imagine. I would ballot for a non-permanent Militia, for an extra battalion if you choose to call it so; I would ballot for another 150,000. By that means you would have an organization which is so much wanted in this country, so that in a moment of danger you would not be all abroad, all confusion, all hurry scurry. I would like to see the ballot put on in the different counties, the men told off, their names and residences taken down, and I would impose a penalty if any man went away from his county without giving his change of residence. For the first year or two I would not call them out, but there would be this great advantage, you would know where the men were, and would be able in forty-eight hours to call out that other 150,000 men. They would form a Reserve Militia. I would also say a word upon another force that I belong to, the Volunteers. It is not my intention to weigh the two forces, my sympathies go with the Militia. The Militia constitutes the back-bone, the sinews of England; but we should have this advantage with respect to the Volunteers, that the system of balloting I propose, would drive a large number of men into the Volunteers; the men who would not like to serve in the Militia, would go there. Then you would gain another great point, which perhaps you are not aware of, you would be likely to draw away many from the Volunteers who ought to be in the Militia. I believe that at the present moment you have in the Volunteers a large number of men who have no business to be there, who more properly belong to the Militia, and if they were not indirectly receiving money from the State, we should have them in this latter force.

This is a matter of great importance, because when the Volunteer force was first started, it was never supposed to be a paid force in any shape or way, therefore, I would throw it out for our next discussion whether, among other suggestions that have been made, that suggestion of having a system such as I propose might not be adopted. Connected as I am with the Volunteers, I will not enter on that question, but when we come to talk of the Militia and Volunteers, and of the 500,000 men entered on the estimates, or to talk of their organization, I must say that there is no such thing as an organization, it does not exist. If it came to a question of war, and we were suddenly called upon, we should not know what to do, there would be a perfect chaos; therefore, the sooner we put our house in order the better; and it is only by these discussions and talking these matters frankly over that we can improve. I come back, therefore, to the question of the Militia, whether you could not enforce the ballot upon the class of men who are not called out, and so form a second battalion. At all events you would have this great advantage, that you would know where to put your hand upon 100,000 or 150,000 men; and I am happy to say that such is the intelligence of Englishmen now, so superior is their education, that, instead of taking three or four months as they used to do to become anything like organized soldiers, a much shorter time would be sufficient. Very likely one or two months would make the men thoroughly efficient when once called out; besides this you have the regular Army. We must never lose sight of the fact, that the art of defence is very much changed now. A defensive Army, if organized, and not outflanked or out-manœuvred, has an immense advantage in the breech-loader. You have now in this country 200,000 or 300,000 men thoroughly efficient, and in proper positions, they would be equal to any emergency.

Captain COLOMB: I should like to say a few words with reference to the possibility of blockading our enemy's ports. The noble lord spoke of our present forces. I hardly dealt with our present forces; I dealt with what they would be in time of war; then, there would be no difficulty in blockading the whole of the ports. Blockade, now, since the advent of steam, is a very much easier thing than it was in the old war time. In the old war time it was necessary for a fleet to keep the sea, to keep under sail, because they dared not anchor; they dared not go into sheltered places for fear of a change of wind. All that has passed away. A very small force of steamers could blockade a port, and could not be driven away except by a superior naval force. We have seen instances of that in our own time. We blockaded in the Black Sea, and we blockaded in the Baltic; and the Americans blockaded the whole of the Southern ports with absolute ease. It would be the same with us.

Lieutenant-Colonel DYKE ACLAND, M.P., Devonshire Rifle Volunteers: I feel that an apology is due from me for rising to speak. I observe with very great regret that I have lost the opportunity of being here when the papers were read, and I am very glad to hear that another opportunity will probably be given for carrying on the discussion. I should not indeed venture on taking part in this discussion of the papers but for the remarks that have been made. I was very much struck by what Captain Moncrieff said, that he desired to see the Militia more self-reliant and more capable of action as a body by itself. But I was still more struck by what he said afterwards, as to the want of education and instruction for the Officers of the Militia. My purpose in rising is to put in the strongest possible manner I can, but calmly and quietly, my sense of the absolute necessity for something being done to educate us Volunteer Officers. I am not quite sure that I should carry the whole of the meeting with me if I were to say how that should be done. I have no doubt that military men who have faced danger, and have spent a whole life in military discipline, would not differ from me at all as to the fact that we want education. Undoubtedly we do. But I venture to say, I hope not disrespectfully, that I do not think that the education we want, is simply to be attached to the regular regiments as they are at present. I attached myself once to a regiment, hoping to learn something of the drill; and all that I learned for a good many hours was that the rear-rank man was to uncover by taking one pace to the rear with his left foot and so on. I heard it a hundred times, mixed with certain emphatic denunciations which were not in the drill-book. The thing that I wish to press on the attention of military men is,

the essential difference between the Militia and Volunteers and the Regulars, namely that the Regulars have plenty of time to learn their duties, and we have but little. And it is absolutely necessary, if we are to be taught, that the teaching should be put, not simply in a condensed form, but in an intelligible, rational form; not simply a tissue of directions out of books which we can read for ourselves at home. I do not, therefore, think that it is the most important point for Volunteer Officers that they should be attached to the regular forces to learn their drill, because I think if the adjutants and sergeants in the Volunteers are fitted for their places, which some of them are not, they ought to be able to teach that to their Officers at home. I hope the very distinguished persons at the head of the War Office, and the General who is now placed at the head of the Reserve Forces, will give their minds seriously to this question, whether we cannot have some sort of short staff course similar or analogous to the short musketry course at Hythe, which shall include for us theoretical instruction, not in things in general—not in the history of small arms and all those antiquarian subjects which are mixed up with others at Hythe—not in the history of warfare at a time which has gone past, as a matter of antiquarian interest, but simply and solely in this one practical question, what will you as country gentlemen, you as tradesmen, you as farmers, have to do if England is in serious danger of invasion. Now, I heard an expression fall from the noble Lord who has just spoken. I confess I thought he was a little hard upon Volunteers. I am sorry to say, with all due respect to him, having followed him in a review more than once, that I differ from the noble lord's opinion that what England now wants is a *corps d'armée* organized by Volunteers, and under Volunteer Commanding Officers. I think what we have to learn is, how to organize our own battalions, and how to put our battalions in the best possible position to be absorbed, and to be put under Generals of the regular Army. I think our attempt to form military trains and expensive military establishments is shooting very wide of the mark. You might do something in England, under good guidance, to organize our country people, our farmers, into some sort of transport corps. I think you would find country gentlemen and farmers willing to lend their horses and carts if they saw it was a real practical matter that the country wanted. But what we do not like is taking up time with mere show. I know we are supposed to be men of show, but it is not really true. I assure you that the amount of work that some of us have to do, to get together 3,000 men in a County, or the amount of work we have to cram into 24 hours, is something like three or four days into one. We are simply bent on work, simply on that. Now, we have no education, and we have nobody to teach us. We do not know how to set about serving out food; we do not know how to economize time in getting troops into railways or out of them. Some of us have our own views about it, but some of our views may be wrong. What we cannot stand, is pipe-clay and routine. It is a sort of system which may do very well in the barrack yard, but it does not fit us, simply because we have no time for it. It is really that—we have not time. Therefore, the mere copying of what goes on in the Army, excellent as it may be for the Army—it is something upon which I do not pretend to give the slightest opinion, because without experience no man can form a judgment about it—but what I do say is, that the simple "aping" of the regular Army is not the way to make good Volunteers. I have served in the Yeomanry for 30 years, and I have been under good Adjutants and under very good Colonels. I think in the Yeomanry we have a great deal too much in the way of copying the cavalry. We cannot be cavalry; we cannot have trained horses. Let our men be ever so good, our horses cannot be trained. Of course, the same remark applies to the Mounted Rifle Volunteers. I think that is a crucial instance of the mistake of copying the regular Army. Now, what I have to invite the Officers present to consider, especially the noble lord in the chair, and the Secretary of State for the War Department—what I do intreat them to consider is, whether they cannot give us the opportunity of going to Aldershot or Sandhurst for a week or fortnight; not simply to hear the professor at the latter place read out his lecture—he may do that with great effect to gentlemen who have twelve months before them—but that we may receive from able men lectures adapted to our wants, and that, then, we may be allowed to go out with a flying column, not to have a jolly week in the mess

but that we may be put under the authority of a talented, intelligent, active young staff Officer, who will really give his mind to one subject, namely, that of teaching us what we ought to know. These are the sort of suggestions I would make at present. There are a great many other things which are necessary to make the Volunteers a more useful body than they are at present. Perhaps, I may be allowed to make one remark upon another point. Something has been said about putting the Volunteers under Generals. I do not know whether gentlemen present have seen Captain Phipps's pamphlet on our sham Army. I venture to ask you to read it. He treats our country gentlemen with the most ineffable contempt; he calls us "puppets;" he considers we ought immediately to be sent to the right about, and replaced by gentlemen who have been in the Army. That may be the best thing; that I say nothing about. But I do think there is a great deal in Captain Phipps's pamphlet which deserves the attention of military men. I think he is quite wrong in the idea, which is the back-bone of his pamphlet, that all the Volunteers, Yeomanry, and Militia should be immediately placed under the General of Division. I say that with the most lively and the deepest gratitude to Major-General Hutchinson, Lord Templetown, and to Sir Augustus Spencer, who have been the three Generals whom it has been my pleasure to know. There are no Generals that I could speak of in warmer terms. They are placed under very great difficulties. Under the system of our double government for the Army, it is extremely difficult for them to give us the assistance which they would willingly give us. But these are details which I will not trouble you with. It would be extremely embarrassing for General Officers to be put over men who are not under their command. I think what must be done, is to put us in a position which will make our own work a little more practical, by giving us the benefit of instruction by these Staff Officers. What I wish to urge is this: I want a well-constructed staff, composed of energetic and intelligent Volunteers, and including gentlemen who have left the Army, and to whom it is not convenient, or who do not like, to take commissions in a particular corps. I think there are many young men about the country who have left the Army in a fit of idleness, or for other reasons not so agreeable to their parents, who might go through this volunteer staff course of which I speak; they might wear a Volunteer staff uniform, and be employed in the organization of our Volunteers. There are other considerations which I hope to publish in another form; and I hope I have not been intrusive in what I have said this evening.

The Chairman: Perhaps the meeting would now wish to adjourn this discussion to some future day to be fixed by the Council?

Major Leahy: Before we adjourn, I should like, with reference to Major Edwards' paper, to explain to the meeting the reasons which have induced me to put forward for discussion, propositions having in view the same end, but differing in their character. The propositions in Major Edwards' paper, which we are invited to discuss are:—"1st. To concentrate the Army to a greater extent in the United Kingdom." My reasons for not adopting that proposition are as follows:—The question of military organization divides itself, as explained in my paper, into three heads, the first is political, and it appeared to me, that it did not come within my province to propose discussion on matters settled for reasons that military men may possibly not be cognisant of. The reasons which induce the Government to distribute our Army in the colonies and our possessions abroad, are not before the meeting; I do not, therefore, propose to disturb that distribution. With regard to our regular forces, they are of two kinds. First, those that are permanently enrolled; secondly, the reserves. A question now open for discussion and decision, is how to attach to the regular forces a certain number of reserves, which have been authorized by Parliament to be raised, to increase the regular regiments to their war complement. It appears to me that, if we attach to the regular forces already in the country, the reserves which are authorized to be raised as necessary for completing the war establishments, we should provide the nucleus of *corps d'armée*, without interfering with the distribution in the colonies. With regard to the next proposition:—"2. To divide it into *corps d'armée* of equal strength, and distribute it with reference to them." I do not propose to distribute the Army in *corps d'armée* of equal strength; because the defensive work which the various *corps*

would have to do, differs very much, according to the section of the country in which each is placed. For that reason, I propose the distribution by districts, indicated on the map before you, and in table No. IV

I have laid out the military districts so that the head-quarters of each *corps* should be placed in some centre convenient to railway communication, which, I think is one of the chief conditions to determine the distribution. For the southern line of coast, Aldershot, where a camp already exists, is a convenient situation; and the district has been mapped out with reference to those lines of railway, the South Western lines, that converge in or about Aldershot. The *corps* stationed here would have a very important function to perform. It would be charged with the defence of a long line of coast, its main function being to defend London. It would, in case of expected invasion, occupy the Surrey hills being ready to move on any part of the south coast. It so happens that there is within this district a large amount of existing barrack accommodation, which may be made available for quartering a large number of troops. I therefore propose that in this district the means should be provided for forming the largest army *corps* in the kingdom. The regular Infantry in that district would number about 15,000 men; and reserving a certain proportion for garrison duty, you would have, on permanent pay, a *corps* d'armée of about 12,500 infantry, about half a Prussian *corps*. The Reserves in that district, including the garrison Reserves, would be about 21,000 men. The *corps* would, consequently, have the means of doubling itself by calling in the mere regimental Reserves, without appealing to the Militia. During the summer training, the *corps* might have 25,000 infantry under arms. Calling out the Militia, these 25,000 men might be turned into 50,000. You would have, in this district, the means of forming an army *corps* of 50,000 infantry; which, with a due proportion of cavalry, artillery, engineers, train, &c., represents an aggregate number of between 75,000 and 80,000 men. The next section of the coast liable to attack is that which extends from the Thames, at Gravesend, round to near Brighton. For the defence of that line of country, a smaller *corps* might probably suffice. I propose to place the head-quarters of that district at Chatham, so that with existing railway communication, the troops could be readily thrown on the coast. But if, in the improbable, I will not say impossible, event of an invasion, driven back, they would occupy the line of hills, which would be taken up for the defence of London. That *corps* would consist of about 25,000 infantry, making a total of about 40,000 men, for the defence of the south-east coast. Another point which is liable to the possible threat of an attack is the eastern coast, that of Essex particularly. Harwich is the harbour which it is supposed an enemy would look to for its basis of operations. I propose that the head-quarters of the *corps* acting on the east coast should be in London. Looking to the present distribution and to the existing barrack accommodation, we could have in that district a *corps* of about 25,000 infantry, representing about 40,000 men. We should thus have for the defence of London one *corps* of nearly 80,000 men, one of 40,000, and another of 40,000; that is a total of 160,000 men, including the proper proportion of cavalry and artillery. That is irrespective of Volunteers; it includes the regular forces, the regular Reserves, and the Militia. I next propose to map out the western district, with reference to the railways which converge on Bristol. One railway goes off to South Wales, and the fortress of Pembroke, and another goes off to Plymouth. Although there is no military establishment of any strength at Bristol, a convenient situation for a camp may be found somewhere near the spot marked. I propose to make that place the head quarters of the district. There is a large number of Militia in the western counties, and a camp of instruction should be formed. I propose to concentrate the Militia of the Midland counties at Aldershot. In the northern district there is a large proportion of Militia, and it is proposed to form a camp in some convenient place on the plains of Yorkshire. The functions of the staff of that district would be principally directed to the training of the Militia forces; that *corps* would act as a reserve to the Army for the defence of London. These are my reasons for proposing a distribution of Army *corps*, based upon geographical circumstances and railway communication, and also with reference to the barrack accommodation and Militia in the districts. It appears to me that it is, for our national defence, a better distribution

than in corps of equal strength. With regard to the next point in Major Edwards' paper, "3. To organise the Militia and Yeomanry, so that they can readily join the regular *corps d'armée*," that proposition involves the breaking up of the county organization, which has existed for three centuries. This involves legislation, and an entire alteration of the Militia laws, and unless it can be shown that the existing organization is defective, it appears to me undesirable. I am strongly impressed with the opinion that what we have got to do is to expand and strengthen our existing Militia organization with such minor improvements as may be necessary, and many have been suggested by gentlemen who have spoken here. Colonel Alcock made an important suggestion with reference to the Militia which I think it would be well to bear in mind. It was, that the men who served their regular time in the Militia should pass into a Militia Reserve; just as men who had served a certain time in the regular Army, should pass into the Army Reserve. Colonel Alcock pointed out that many men could not afford 28 days for their regular training, and that these men should be placed in a Militia Reserve. It appears to me that that suggestion is one that could be readily carried out. According to present laws, there is power to increase the Militia force, consisting of 120,000 men to 180,000 men in case of war or invasion. Consequently, there are 60,000 men that might be properly organized out of men who had passed their full time in the Militia, and who might be trained at a different time of the year, or for a shorter time, by the present permanent staff. I think all the gentlemen who have spoken on the subject have advocated the strengthening of the Militia, and the importance of keeping it up as a distinct service, and not as a nursery for the regular Army; that the Army should find its own recruits, irrespective of the Militia. It appears to me that with the present inducements to military service there ought to be no difficulty in doing so. The Militia and Volunteers are for home defence; and in any project for organization, I do not think it desirable to put forward propositions by which they would be diverted from their primary object—the defence of the country. With regard to point 4, "To give to the Field Artillery an organization which will render it capable of rapid expansion," I fully agree in all that Major Edwards has said upon that subject. I hope some Artillery Officer will give some hints and details on the subject. The 5th proposition is, "To form depôts for the establishment and instruction of a reserve of trained men for the different services." For the reasons I have before stated, I think all Reserves should be attached to their own arms of the service: militia reserves to the militia, line reserves to the line. I may state with reference to Captain Colomb's remarks, that my reason for not entering into the question of naval defence was, that I thought the paper already went into too many subjects, or I should not have left it untouched. I cannot coincide with all that Captain Colomb has laid before the meeting with reference to the impossibility of an enemy landing in this country. I fully appreciate, and have borne in mind the fact, that the naval forces must be our first line of defence. But I cannot bring myself to believe that all he says about the facility of blockade is practicable. In former wars our ships were independent of coal, but in these days of steam, armour-plated ships and ships of small size cannot remain out of port for any length of time without coal. With regard to Colonel Robertson's remarks, he will find that the suggestion of recruiting for two terms of enlistment is embodied in my paper; but I did not consider the question of the conditions of service was one which could be appropriately discussed, and, therefore, I did not propose to touch upon it. I do not know that there were any objections taken to my propositions, but I thought it right to explain why, having the same desire for organization in view, I propose different means of arriving at the ends that are proposed in Major Edwards' paper.

Major Edwards: I should like to make a few replies to several statements that have been made, and with regard to my paper in particular. General Boileau first of all spoke about the military train not being sufficient. The eight troops of military train, as laid down by the Committee, are merely taken as a starting point. I do not know whether that number is sufficient or not: I should say it is not one-third of what we should require for active service abroad. But in this country it would serve as an admirable nucleus for all that we should require. He also stated that a

military train—I mean of wheel-carriages would be of no use in India. Having served but a very short time in India, my opinion is of little value. But what I mean by attaching a military train to the *corps* in India has been explained by Colonel Ewart, that you would have a large body of non-commissioned officers and men from whom you could form trains of different descriptions as you might require them for different services. If Sir Robert Napier had ordered a division of one of my *corps d'armée* for service in Abyssinia, it would have had with it a portion of its military train; and when they landed on the coast of Abyssinia, they would have had officers and men who understood their business, who could have at once formed the Land Transport Corps into something like an organized system, instead of having to create it in time of war. I stated in my paper that the Native troops should supplement the European troops in certain tropical colonies. What I meant to say is, that that system which has existed for some years in China should be generally carried out; because Europeans are called upon to do all sorts of duties which destroy their health, and which can be done just as well by Natives. I think the European soldier is too valuable an article to be thrown away in that way.

Colonel Ewart recommended divisions instead of *corps d'armée*. I have given the name *corps d'armée* to this body of 16,000 men, because that is the name adopted by the Committee of Officers assembled to consider the equipment and supply of an army in the field. But it is really only a division of the Prussian army; and I have taken it as a nucleus, because when it is doubled it makes a *corps* of about as large a body of men as can be brought together for tactical purposes. Major Leahy recommends some *corps* of very considerable strength; but it was found in the late campaign in Bohemia that the Prussian *corps* of 32,000 men could better act by divisions of 16,000 men for tactical purposes. It has also been stated that we have now a large body of staff officers, who have been trained in the Staff College, and available for any duty. Unless some system is established by which these staff officers may know how to work,—unless they can know what their work is to be in time of war—I mean unless a system is established for them to act upon, I do not see how they can be of much use. Colonel Ewart also stated that the *corps* such as I propose was not suitable for Abyssinia. In my paper I recommended a *corps* organization for India; but I do not strictly adhere to that, because I do not so much care about the organization of the army *in India;* our great object should be to organize the Army in *this country* for the purpose of resisting invasion, and for sending an army on foreign service. I merely threw out this suggestion for the establishment of *corps* in India to fall in with the organization of the regular Army. But I still maintain that the establishment of *corps* in India would be of the greatest advantage. Does anybody know the number of portions of different *corps*, small bodies of men that are now serving with the Abyssinian expedition? There are, I do not know how many portions of different regiments of Native cavalry and infantry; whereas a division of one of my *corps* would have formed a body of 14,000 or 16,000 men accustomed in time of peace to act together; consequently, when they went on service, they would know their work very much better than they could do, if suddenly brought together for active service in the field. In a remote country like Abyssinia where they have not been called upon for actual service in the way of fighting, it does not so much matter. It has been suggested in Major Leahy's paper, that encampments should be formed. With that I entirely agree. And I have suggested in mine,—"the occasional exercising of our troops in camps." The organization which I proposed for the Militia and Yeomanry, was with the view that they should at once join the regular *corps*, and go into camp for a short training. I entirely agree with what Captain Moncrieff has stated, and I think if he will do me the kindness to read my paper, he will see that most of his propositions are met in it. There seems to be an idea that the Militia should be organized on its own basis. But I think it must be organized with the view of joining the regular army, because it is impossible that it can act efficiently by itself; and the great object in organizing all our various forces is, that they should at once be able to form a regular Army. The system which I propose for the Militia, I threw out as a tempting bait in the hope that some distinguished

Officers in that service, who could enlighten us on the subject, would come forward and state how that object could best be gained. We have heard a great deal of hundreds of thousands of men, but all these men are of no earthly use, unless the different arms of the service are duly proportioned to each other. That is an opinion which I entertain most strongly. I mean this, that a thoroughly organized and equipped army of 80,000 men, with all its different services complete, is more than a match for 150,000 men without organization, the greater proportion of whom are infantry, with very few field artillery. Therefore, I would rather see the Militia reduced at present, so as to make the number, whatever it may be, perfectly efficient. The system which I proposed was the best that suggested itself to me at the time, and I very much wish that Officers who can give an opinion on the subject, will come forward and really assist us, because it is, perhaps, more a political than a military subject. There is one subject that Lord Ranelagh mentioned, that Volunteers should not be a paid force. That I think everybody will agree with. I believe the original intention of the Volunteer movement was, that it should train many of the able-bodied men of the country in the use of the rifle. In these days simply to know the use of the rifle is of very little use without a certain amount of drill to enable men to act together; they should therefore also be trained in their company and battalion drill. I entirely agree with Mr. Dyke Acland, that the Volunteer organization is essentially battalion, and that it would be almost impossible to attempt to give it an army organization. The battalion organization would place at the service of the State in time of need a great number of men who would be invaluable in the defence of the country. Perhaps, it may be exaggerating the mark, but I have always thought that for the garrisons of our different dockyards we should require 150,000 or 160,000 men. At least that number of men could be placed in those garrisons, and the greater mass of our Volunteers would find plenty of occupation in protecting our dockyards. The more efficient battalions might at once be brigaded with the infantry of the regular Army. Major Leahy has stated that he does not consider the various army *corps* should be of equal strength. I hold that it is the groundwork, and the principal basis of an efficient army organization; because if these *corps* are of a different varying strength, you can have no uniform system among your whole Army; and a *corps* of 65,000 or 70,000 men must be divided into smaller *corps* to make it of use for service in the field. I wish to see a system introduced in time of peace, which will enable the whole of the Militia of the country at once to fall into their places in time of war, because I do not imagine that anybody supposes, that if such an event as an invasion of this country did take place, any great amount of time would be given for preparation for it. We have also heard Captain Colomb make some remarks as to the possibility of invasion. This, however, is more a political than a military question. Being employed at present in the construction of some of the largest forts in the kingdom, with the view to protect a dockyard from an army landing in this country, I naturally come to the conclusion that the country may possibly be invaded.

The CHAIRMAN: If it is the wish of the meeting that the discussion should be adjourned, the Council have named the 11th of June* for the renewal of such observations as gentlemen may then wish to offer.

General BOILEAU: Before the meeting adjourns, I trust I may be permitted to offer our thanks to the noble Lord for his kindness in presiding over us this evening, and to request that he will again favour us with his presidency at the adjourned discussion.

The CHAIRMAN: I beg to return you my thanks, but I do so only temporarily, as we are to meet again.

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* The discussion was not taken on that day, but was adjourned *sine die*.—ED.

The following memo. has been communicated by Major Leahy :—

"Sir C. E. Trevelyan, in pages 53, 54, and 64 of his pamphlet, entitled 'The British Army in 1868,' published subsequent to this discussion, adopts the views and calculations set forth in pages 17, 18, and 19 of my paper (see pages 326, 327, and 328), as printed for private circulation before its appearance in this Journal."—A. L.

TABLE I.

OUR INFANTRY FO...

...ns, Brigades, and L...

and West Indies		4 4/10	44	158	9	215	88	2,
Mauritius and China ..		4	40	144	15	200	80	2,
Colonies.								
Australia and New Zealand............	74	4	30	108	6	150	60	1,
Cape Colonies		3 6/10	36	130	7	184	72	2,
British North America .		15	150	540	30	750	312	9,
Ceylon and Straits Settlements		2	20	72	6	100	40	1,

TABLE IV.

Local Militia and Volunteers (about)....	..	..	..	..	198,000
Ceylon, Straits Settlements, Cape, and Australia.					
Infantry Battalions ..	9	86	328	6,336	..
Local Militia and Volunteers (about)....	..	..	..	..	15,000
India.					
Infantry Battalions ..	52	520	2,028	43,934	..
Local Infantry (about)	..	..	1,366(1) 2,401(2)	101,073	..
Total Infantry Forces					

(1) European. (2) Native. * Trained Bands

B... Head... | No. N.-C. Officers and Men. | ...on ...rters.

SOUTHE... ...don. Head Quar...

Brigade Head Quarters.

an	1,064	Dublin (1).	Dublin (2) Gds.	1,064
sei	532		Do. (4)......	2,128
rbı	532	Curragh (1).	Curragh (2)	532
			Kilkenny (1)....	532
ıes	532		Athlone (1)	532
er	532	Belfast (1).	Enniskillen (1)..	1,064
(4	532	Cork (1).	Belfast (1)......	1,064
cli	532		Templemore (1) .	532
	532		Cork (2)........	532
	532		Kinsale (1)......	1,064
	532		Waterford (1) ..	532
	532		Fermoy (2)	532
		Cavalry (1).	Limerick (1)	532
Bat	6,384	5 Brigades.	20 Battalions.	10,640
d 1 18		Camp. Curragh.	Royal Marines. 677.	
soı		Fortresses.	Garrison Corps.	
an		Cork.	Dublin (1)......	258
ıes (1			Cork (2)........	516
				11,614
es	7,872	Reserve Stores.	Reserves	14,090
	14,256	Dublin.	Total ..	25,704
fil			Militia.	
	3,744		Irish	28,759
n	21,237	Barrack Accommodation.		
er	8,337			
Ke dc		Officers .... 1,859 N.-C. O. & Married Men...... 1,936 Men ... . 34,222 Horses, Troop 6,187		
tt	33,318		36 Battalions.	28,759
n	47,574		Total Infantry ..	54,463

Evening Meeting.

Monday, May 4th, 1868.

REAR-ADMIRAL SIR FREDERICK W. E. NICOLSON, Bart., C.B.,
Vice-President, in the Chair.

NAMES of MEMBERS who joined the Institution between the 27th April and 4th May, 1868.

LIFE.

Howes, Henry, Captain King's Own Light Infantry Militia. 9*l.*

ANNUAL.

Barnard, L. H. J., Ensign Rif. Brig. 1*l.*
Scott, W. C. E., Capt. 3rd W. I. Regt.
Glennie, Farquhar, Lieut. 9th Regt. 1*l.*
Wright, A. F. B., Lieut. 9th Regt. 1*l.*
Wilson, Chas. T., Capt. 4th K. O. 1*l.*

THE "MACKAY" GUN AND PROJECTILES.

By the Inventor, JAMES MACKAY.

Read by Major-General BOILEAU, R.E., F.R.S.

WHEN the great question of guns and armour became so prominent before the country, I determined to ascertain whether there was not a principle by which hard, unexpansive, elongated, smooth, cylindrical projectiles could be fired on end from smooth-bore guns so as to strike the object aimed at, on end.

With that object in view, I purchased a smooth-bore Enfield gun; and after firing from it 1,600 rounds of steel shot of various forms, I discovered that a projectile for such a purpose must be so formed as to receive a preponderance of the explosive force upon its shorter lines or axis whilst in its passage from the gun, to encounter the resistance of the air upon its longer lines or axis; in other words, it must be so formed and balanced from the centre of its length as to retain its axis of its own accord during its passage along the line of fire.

On the 27th of January, 1863, I was permitted to fire at Shoeburyness three of these cast-iron projectiles of my make.

The gun used was an 113 cwt. 68-pounder cast-iron smooth-bore. It was placed at a distance of 200 yards from a section of the "Warrior iron-plated target."

I was only permitted to use 9 lb. charges of powder, and as one of my projectiles weighed 115 lbs., and the other 125 lbs., it only gave 1 lb. of powder to every 12¾ lbs. of shot for the 115-pounder, and 1 lb. to about 14 lbs. of shot for the 125-pounder. It must be admitted that this proportion of powder was very small.

These experiments were carried out under the direction of the President of the then Iron-plate Committee. There were also members of the Ordnance Select Committee present.

I received extracts of a report from the latter Committee, stating that the effect of my shot on the target was considerable, but it was not stated to what that effect was mainly due. I regretted that very much, being desirous of ascertaining the Committee's opinion as to the reason why, in my opinion, one of these elongated projectiles of mine fired with so low a charge did as much, and more, damage to the target than six sphericals fired from the same gun, at the same experiments, with double the charges allowed for my projectiles, viz., 18 lbs. of powder to a 68-pound shot, or 3½ times greater in proportion.

I think the lesson taught by the work of these projectiles of mine was very striking, as showing the importance of a steady flight at that early stage of the inquiry, as the extra effect upon the target could not have been due to the small charge of 9 lbs. of powder.

I am aware that the windage on my shot was very little; but that made little or no difference in their striking power.

I allude to these experiments merely for the purpose of showing that (from the experience gained by my practice with the smooth-bore shoulder-arm) I did succeed in shooting hard, unexpansive, elongated, non-rotary projectiles on end at the first trial from the 68-pounder smooth-bore gun; and to state that a member of the Ordnance Select Committee informed me at the same time that they themselves had not succeeded in so doing.

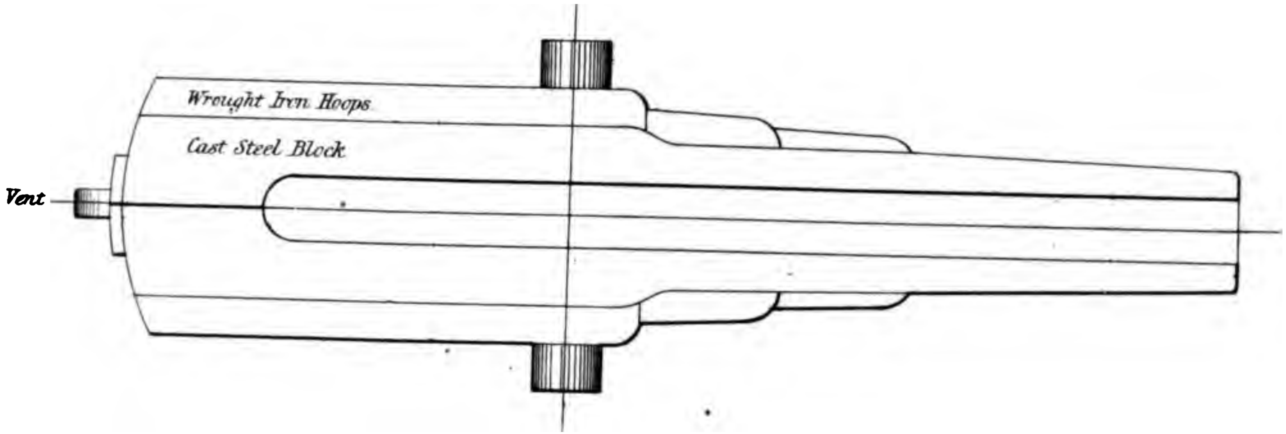
Some persons have put forward claims without the information afforded by practical experiments, that spiraled, elongated projectiles can be practically and successfully rotated from smooth-bore guns, by the explosive charge operating upon the spiral grooves or bars formed on the surface of the projectile; but this method is impossible as a practical working operation in gunnery, unless the elongated projectiles be made on my principle, as already stated.

Other kinds of shot must fit the bore so accurately as not to allow any windage; and even then the rotation obtained is imperfect. One shot may hit middling fair by mere chance only; the next tumbles over, and so on. The reasons are, that the gun is the fixed body, the shot, the movable body. The gun having a smooth-bore, the resistance of the spiraled projectile is not sufficient to cause the longitudinal tendency of the explosion to be diverted into an even spiral course along the chase; besides, there are no means of centreing the projectile in the gun during its passage to the muzzle.

The difficulty in procuring a perfect spin upon this method deter-

SKETCH OF A "MACKAY WINDAGE GUN" FOR FIRING SMOOTH CYLINDRICAL ROTATING PROJECTILES MADE OF HIS HARD METAL.

Scale ½ in to a Foot.



N.B. This system admits of various modifications in practice

Pasteboard or other Wad which may or may not be used

NOTE.

Windage two Grooves or more.

J Jobbins

mined me to groove the guns; and with this object in view, I purchased 12 smooth-bore Enfield guns, and grooved them for windage. This was the origin of what is now known as the "Mackay Windage Gun."

One of these windage guns had spiral grooves, with a twist of half a turn in the length of the barrel, which was 39 inches; in each of the others the twist was increased, the last of them having eight turns.

With these different guns I fired over 3,000 rounds of spherical and elongated hardened steel shot at iron and wooden targets, in comparison with other guns. My object was to acquire, through my practice with these shoulder-arms, the effect of the high windage spin to the shot, as a starting point, from which to construct heavy guns for the purpose of destroying iron armour.

Therefore, in speaking of the spiral grooves formed in the windage gun, it is necessary to dismiss from our minds altogether the word "*rifling*." The windage gun is not a rifled gun, in the understood sense of that word, as applied to guns.

I will endeavour to prove this.

In the rifled gun, the shot fits into and follows the grooves.

In the windage gun, the shot has no connection whatever with the grooves.

In the rifled gun, the rotation of the shot is fixed along the chase of the gun.

In the windage gun, the shot takes the mean of rotation due to its velocity.

In the rifled gun, the grooves are filled by the rifling on the shot.

In the windage gun, the grooves are left open for windage.

In the rifled gun, the shot must be adjusted to the grooves when being loaded.

In the windage gun, the shot requires no adjustment to the grooves.

In the rifled gun, the studs filling the grooves leave no room for the escape of air, when the shot is being rammed home.

In the windage gun the air escaping up the open grooves when the shot is being rammed home, admits of very rapid loading.

In the rifled gun, the shot being studded, rifled, or lead-coated, is subject to injury which may prevent its loading.

In the windage gun, the shot having no such attachments, may be roughly used, and yet not prevent their loading.

In the rifled gun, in order that the shot may load with a chance of certainty, it is necessary to allow the $\frac{8}{100}$ of an inch windage space between the body of the shot and the bore of the gun, to account for the chances of lateral deviations in the fittings, between the grooves in the gun, and the fittings on the shot.

In the windage gun the smooth shot rests on the lands, showing all the windage on its upper portion, requiring no allowance for deviations.

In the rifled gun the working windage, or the difference between

the diameter of the shot over the studs, and the bottom of the grooves in the gun is only the $\frac{5}{100}$ of an inch; thus, whilst the windage in the service rifled gun appears to be the $\frac{8}{100}$ of an inch, the actual working windage used is only the $\frac{5}{100}$ of an inch.

In the windage gun there is nothing on the shot to occasion the necessity of two diameters between the shot and the bore of the gun.

When the rifled gun is fired, the studs are forced through the grooves, resisting the natural longitudinal course of the explosive charge, they ride on the edge of the grooves, generating during their passage out of the gun a melting heat; this operation in rapid firing must draw the bore off the circle, and quickly render it unserviceable.

When the windage gun is fired, the front of the shot is resisted only by the air in the gun.

When the rifled gun is fired, the tendency of the explosive force is longitudinal.

When the windage gun is fired, the tendency of the explosive force is rotary.

These comparisons will serve to show the distinction between the two systems, and that the rifled gun is not a windage gun, nor the windage gun a rifled gun.

I allude particularly to these distinctions, because the use of long or round shot in the rifled gun has no analogy whatever to the use of long or round shot in the windage gun, even upon technical grounds, and in speaking of the operation of the projectiles fired from the two systems, the difference is still greater.

My experiments have proved satisfactorily that the proper shooting of hard, unexpansive, elongated, rotary projectiles is a very difficult matter; this, I think, has also been abundantly proved at Shoeburyness, if we examine the history of rifled experiments made there; there are so many obstacles in the very nature of the art itself to overcome and guard against.

1stly. The projectile should be cylindrical.

2ndly. The projectile should be delivered from the gun with its axis on a line with the axis of the bore.

3rdly. The rotation of the projectile should diminish equally, and in proportion to its onward flight along the line of fire.

4thly. The rotation of the rifled projectile, being a fixed rotation, the charge of powder in all cases should be nothing more in quantity and strength than sufficient to impart to the projectile the initial velocity due to its rotation.

5thly. It is questionable whether the proper mean of these two velocities, by which at every round even results are obtained on striking armour along the line of fire, can be practically procured upon the rifled projectile system as now in practice, paying regard to the safety and durability of the gun.

6thly. When the projectile is lead-coated, the force of the explosion packs the lead unevenly on its base, occasioning very weak shooting.

The facts are these, that elongated rotary projectiles have three

distinct motions during their flight from the gun, viz., the onward, the rotary, and the hobble motion.

This last motion is very difficult to rectify in rifled projectile guns, for, if not defined, the projectile will describe at each end two eccentric circles in the air during its passage along the line, each of these circles being more or less described, dependent upon many causes.

A projectile having this hobble motion when impinging on armour, does so obliquely, but it does not finish its blow in the same oblique direction. This sort of firing should, in my opinion, be termed hobble-firing, inasmuch as it is imparted to the projectile by a bad system of shooting.

Oblique firing, properly defined, is that in which the projectile strikes the target on a line corresponding with the elevation of the gun.

I have alluded to the practice with rifled projectile guns as at present constructed, for the purpose of comparison, and in order more clearly to indicate the course of my enquiry into the subject.

It seems evident that, with the difficulties enumerated in respect to the practical working of such guns in the hurry and bustle of actual war, a person following up the enquiry with a view to improvement would desire to obtain some method more suited to the rough and ready purposes required. I do not wish it to be understood by these observations that I condemn the rifled system altogether, but that I say that, if rifled guns and rifled projectiles must be used in the service to the exclusion of all other systems, great improvements can be made upon their present construction: I think, moreover, that my windage invention is an improvement on the present rifled system in many ways.

I have said that the body of elongated projectiles should be cylindrical, and made of one hard metal to retain their shape when the gun is fired; this accomplished, the next thing is to deliver them from the gun, with their line of axis on a line with the axis of the bore.

My windage system of guns accomplishes this object with a practical and serviceable amount of longitudinal windage between the shot and the lands of the gun. Should it be asked, "what I consider a practical amount of that windage to be," my answer would be, "That by which the windage system will defeat any other system of guns at present in use in rapid firing, before or after the projectiles for both systems have been subjected to very rough usage, each gun loading at the muzzle, other systems using the service windage."

I have also said that the velocity of the shot should diminish during its flight in proportion to its rotary velocity; this also the windage system accomplishes.

The shot having no hold upon the gun, the rotation diminishes towards the muzzle by the slip of the projectile; the grip of the explosion and wadding upon the projectile is less at the muzzle than at any other part of the bore.

My experiments have proved the overwhelming advantages of this sliding motion of the projectile, by which the gun is cleaned at every discharge, and by which it takes the mean of rotation due to its onward velocity.

If an increased charge be used, an increased grip is procured upon the projectile to correspond with the increased initial velocity due to the increased charge.

The invention of the "Mackay" gun is to meet practically the many obstacles by the use of shot which have no connection with the bore of the gun (as in smooth-bores), which shot having a sliding rotation seem to be from my practice more accurate and powerful than any others.

If this be so, it is not easy to overlook the cheap fabrication of the windage projectile, and the many other advantages of such a system.

Persons who are known to have much experience in artillery practice, have deemed that the windage gun does not rotate its shot, although my 3-inch muzzle-loading gun defeated the service breech-loading gun in June, 1865.

There seems to be a division of opinion on this point amongst artillerists, as another admitted that the shot did rotate.

My opinion, as the inventor, of course, goes for little against such authorities, but such as it is I will state it, viz.:—

That no shot fired from any other system of guns possesses so perfect a spin; I call it "spin," because the word rotation does not seem to suit the motion of the windage shot.

In manufacturing operations, high spinning motions are obtained by straps or belts; the strap or belt is put over a pulley connecting it with a drum from a main shaft, and when the engine which drives the main shaft is set in motion, the pulley spins rapidly round; let us suppose that this pulley is the driving motion of a lathe, and that the workman is turning a shot, if the tool cuts so deep as to stop the spin of the lathe, the belt slips on the pulley, and the tool is preserved from breaking; just so is the operation of the windage gun.

The firing of the gun represents the starting of the engine; the operation of the belt upon the pulley represents the wadding and explosion surrounding the shot, by which the necessary spin is obtained.

On the other hand, suppose this spinning motion a rigid motion by cog and wheel, the operation would be, that either the tool or cogs would be broken, or a deep groove cut in the shot.

There are those also, who make objections without explanation; we will suppose one of these objections to be, that in the case of shot or other missiles breaking in the windage gun, or by the firing of grape or other compounds, the chase of the bore will thereby be cut away, and the gun become unserviceable.

These suppositions, advanced by practical artillerists upon mere surmise, to those who know but little upon the subject, are decisive for the time being against an inventor, particularly when he is not permitted officially to prove its fallacy, however much he may have done so to his own satisfaction.

Let us see how much force there is in such an objection.

In the first place, the space between the front of the missile in the gun, and the muzzle is filled with air. If we compute the velocity of the explosive charge by the pressure of 180,000 lbs. more or less on every square inch of the base of the projectile, we ask the reason

why the projectile makes only 1,400 or 1,500 feet initial velocity per second from the gun?—this velocity cannot be what is due to such a pressure when the gun is fired; there must be some tremendous resistance to the expulsion of the projectile from the gun besides its own weight.

That resistance in the windage gun can only be the resistance of the air in front of the shot.

I have no means of computing the amount of that resistance, or the amount of pressure on the base of the shot, but in the windage gun, a preponderance of it along the chase of the bore rests in the grooves; the instant the charge is fired, the shot is forced into a whirlpool of air, gathering the missile to the centre of the bore, whilst the revolving explosive charge is the acting whirlpool of force on the base of the projectile.

Take for example, an eight-inch windage gun having a bore of 12 feet in length, and windage grooves of two complete turns in the length of the bore, the length of these grooves will be 4 feet longer than the axis of the bore; the explosive force along the chase of the gun has 16 feet to travel before arriving at the muzzle, whilst the axis of the shot has only 12 feet to travel.

The air along the chase of the bore in front of the projectile has also a proportionate tendency, so that keeping in view the great velocity of the charge on the chase of the bore over that of the axis of the projectile, very little reflection will serve to show that it would be simply impossible for broken pieces or compound missiles to injure the gun. I have contended, whether rightly or wrongly, that the windage system of gun has a greater striking power than any other.

If what I have just stated be true, a windage gun of 12 feet length of bore is more powerful than a smooth bore or rifled gun, having 16 feet length of bore, which has a column of 4 feet more air to expel from the gun, with a less density of force, in the proportion that 12 bears to 16. The great object in penetrating armour should be to apply the greatest possible force in the gun upon the base of the projectile, in order to procure the highest possible initial velocity. The gun which consumes or burns the largest charge of powder in the smallest space before the shot arrives at the muzzle, will certainly give the greatest velocity.

I have found that the windage gun will burn one-half more powder than any other gun, and this is very important, because, we can use a slow-burning powder, and at the same time procure the force of quick powder, which is destructive to the gun; besides, it is a very important matter to have as little smoke as possible in firing:—when the powder is consumed in the gun, the flame burns the smoke: this quality of my windage gun is well known at Shoeburyness.

I will sum up these arguments in favour of its power in this way,—that in consequence of the revolution of the explosive charge and cartridge wadding having a longer distance to travel along the chase of the bore, the powder is disturbed by this revolution, and completely consumed, thus densifying the force upon the projectile, whilst the longitudinal portion of the air in front is four feet less resistance to the

shot, besides, the weight of these four feet of metal taken from the muzzle, and added to the breech of the windage gun, would give a much more powerful gun of the same weight.

I will now allude to the formation of projectiles, which, I think should be so made as to allow the wadding and powder to surround them; this assists in keeping them level on a line with the bore when fixed.

During my practice, I tested numerous forms of elongated shot, but in all these tests, I have been led to one conclusion, viz., that elongated, rotary, projectiles should be semi-circular, or nearly so at both ends; the front semi-circle, for convenience sake, in some cases being drawn from a somewhat smaller radius similar to the model. My opinion is, that this formation of an elongated projectile is somewhere near a mathematical truth, because, in the first place, no shooting can be perfect unless the projectile is packed out at the muzzle of the gun by a sufficient quantity of unburnt powder or wadding.

In arms fired from the shoulder, the leaden projectile performs this office by expansion, and so in firing unexpansive shot, a substitute must be employed to cover the windage.

The formation of my elongated projectiles has been obtained after a long practice, by a most decided and marked superiority in their favour.

I have found them to proceed with greater steadiness through the air than any other rotary forms which I have tested. It seems to be a law that round ends and straight lines along the cylindrical surface of the projectile should be the true shape.

The modification which I have made by reducing about one-third the length, more or less, according to the total cylindrical length, is an improvement under some conditions.

There can be no question about the importance of having the centre of gravity in the centre of the projectile; this, to a degree, rectifies its hobble motion. There are two things to be considered on this point. The first is that the support of the air on the full-fronted shot tends to counterbalance the force of the explosion at the instant of the shot's departure from the muzzle. On the other hand, there seems to be little doubt that the reduced shot, once fairly delivered from the muzzle of the gun, produces a more even tone during its flight.

Again, the ricochet of these semi-circular projectiles is very good; they are not so liable to tumble over on striking the ground as square-bottomed projectiles, and their range is also good. As regards their front for penetrating armour, this is a question upon which much research has been made, but my experiments have led, I believe, to different conclusions on this point.

It seems to me undeniable, that the front of a projectile should be so formed as to cut a front hole in the armour of its own diameter, to prevent the side wedging of the armour upon it during its passage through.

It also seems to me undeniable that when an elongated projectile is hurled against armour it should be so formed as to cause every particle of its metal to support each other to save it from destruction;

in other words, to prevent the heavy bottom of the projectile from overpowering and breaking up the lighter front.

It may be thought that a sharp-pointed projectile will effect greater penetration, but I have found, as the results of numerous experiments, that it is much easier to force a block out of the plate of the shot's diameter than to wedge through it a long shot with a sharp point; but in saying this, in order that I may not be misunderstood on so important a point, I must explain that the windage gun spins its shot with an evenness, and at a speed unattainable upon any other system.

In this may lie the explanation of the excellence of the semi-circular fronted shot over others which I have tested, because, at the instant of impact, the semi-circular front, assisted by the high-spinning motion, draws the face of the plate impinged on towards its centre, thus cracking the iron around it, until the circle has fairly entered the armour. This much accomplished, the projectile is saved from destruction, inasmuch as the rolling of its cylindrical surface on the edge of the hole thus made, preserves it from breaking, and allows it to perform its work.

On the other hand, the sharp-pointed projectile, when fairly entered into the plate, breaks its point off, thus destroying its performance.

I am assuming, that these different forms of projectiles proceed fair to the armour upon their axis, free from any hobble motion, because the distinction is much greater in favour of the semi-circular projectiles under other circumstances.

If I am asked for further proof why I consider my projectiles of superior form to all others, I will advance the argument, that the windage gun imparts the two motions to the projectile by one and the same agency, viz., the explosive force. The consequences are, that the means of ascertaining the true principles on which a projectile should be formed, are at hand by the very nature of the system itself.

I will next show the working difference between the windage gun and the smooth-bore gun, which latter up to the successful experiments with my elongated projectiles, at Shoeburyness, on the 27th of January, 1863, has been used only as a round-shot gun.

There can be no doubt that the smooth-bore gun, with heavy charges of powder, throws round shot with considerable smashing power at short ranges; but the great drawback is, that it neither centres or spins its shot, consequently the ball rolls when the charge is fired, grazing the bore from side to side, and, on leaving the muzzle, continues to roll in its passage through the air, in a position corresponding to its last graze in the gun,—the effect of this rolling is very detrimental to its velocity and accuracy, and particularly so to its penetrative power, inasmuch as the inclination of its force, to a great degree, may be said to be lateral, vertical, or edgeways on the armour, producing a kind of oval indent.

One of the first conditions in penetration is to project the shot, whether elongated or spherical, in the best manner to save it from destruction.

A gun failing to meet this requirement, however good it otherwise may be, is not a proper tool with which to fight iron-clads.

The smooth-bore sadly fails on this point, when the plate is of the thickness of the shot's diameter.

Much has been said and written about the resistance of armour, increasing as the square of its thickness increases, but I hardly think it will be asserted that a 6-inch ball, fired at a 6-inch plate, will perform as much upon it as an 8-inch ball at an 8-inch plate, both shot proceeding at the same velocity.

I have found that the windage balls break through all these calculations.

The real truth is, that my experiments have proved that nothing but the very high, steady spin of the windage shot will enable it to perform the work due to its fabrication and the charge of powder used, and give that starting point, from which these calculations can be made.

I will re-state the meaning of this paper, and the conclusions to which I have arrived, by alluding to the armament of our Navy.

Every artillerist is aware, that the ricochet of elongated projectiles upon the water is not to be compared to the ricochet of round shot; therefore, the conclusions are, that for sea-fighting, the elongated shot is inferior to the round shot, because, if the artillerist misses the enemy, long shot will do little after grazing; whilst a round shot grazing in front of a ship, may prove very destructive: moreover the chances of hitting the enemy are in favour of the round shot in a seaway. I am of opinion then, that guns on my system will prove the most powerful armament for iron-clads yet produced, since, in addition to their powerful shooting of elongated projectiles, their shooting of round shot is unparalleled in excellence to those fired on any other system.

A round shot from the smooth-bore plunges in the water, whilst a round shot fired from the windage gun has a much flatter trajectory, and skips along the surface.

I do not consider it necessary to support this writing by referring at length to the numerous experiments which I have carried out with the windage guns, as many of them have been fully and accurately reported in the public press from time to time, and have been witnessed by officials and artillerists of high standing; but it appears necessary, in order to show that the windage guns have perfect accuracy, to say, that my 12-pounder worked under official orders, at Shoeburyness, hit a target 9 feet square, distant 1,000 yards, 12 times out of 15 shots fired, and with projectiles and cartridges exactly similar; it made for rapid firing loading at the muzzle, 25 rounds in 6 minutes 25 seconds.

Although this practice may be considered good, I have, on the Crosby Sands, fired 21 consecutive rounds at a target 9 feet square, distant 500 yards, and placed every shot in the bull's eye, or in a circle of 18 inches, therefore, I do not think that any one can dispute the perfect accuracy of the windage gun.

As regards penetration, my 6-inch gun, with long shot weighing 82 lbs., with 22 lb. charges, penetrated a 6-inch plate with the greatest ease, at 75 yards from the muzzle, and buried the shot 7 feet in the sand beyond.

This same gun, with a 25 lb. charge, penetrated the "Agincourt iron-plated target, and the projectile carried away the backing, and passed many hundred yards beyond.

Again, this gun was fired at an 8-inch plate; the projectile buried itself in the plate, which was thrown over by the impact of the shot; and I have the authority of Major Klercker, who was present, to say, that if the plate had not given way, penetration would have been complete. This same gun at 18 degrees of elevation, with 12 lb. charges, throws its shot about 600 yards.

The 8-inch windage gun, with spherical shot, and 14 lb. charges, penetrates through a 5-inch plate at 75 yards, and the shot proceeds 1,000 yards beyond. The same gun with 30 lbs. of powder, penetrates through a 6-inch plate, and 780 yards beyond.

Some of these experiments were carried out in presence of members of the Ordnance Select Committee.

With the exception of the shot at the 8-inch plate, none of these experiments showed the full destructive power of the windage gun.

I may also add, that in 1864, the 8-inch gun with five elongated projectiles, fired with 30 lb. charges of powder at the "Agincourt target," distant 200 yards, penetrated through at every shot, driving from the target $1\frac{3}{4}$ tons of iron and backing.

I will just advert to windage breech-loading guns, to ask, what system could be more desirable for such a purpose?

I have understood that breech-loaders are to be discontinued in the Service, but looking at the advantages of breech-loading shoulder arms, it is a question whether it is a prudent course to condemn breech-loading artillery without further inquiry.

I have constructed a 12-pounder breech-loader windage gun, with which I have discharged 8 rounds in a minute, and which could be used in an instant as a muzzle-loader.

Mr. Mackay gave the following additional explanation regarding the formation of his elongated smooth-bore projectile, which is made as follows:—A cylindrical bolt cut flat at each end in the proportion that 11 inches long bears to 9 inches diameter is reduced at one end to a semi-circle, the other end is cupped out similar to the model, sufficient to cause it to balance from the centre of its length when finished. An elongated projectile of this form proceeds on end at a high initial velocity from the smooth-bore gun, and is the most powerful missile used from smooth-bores at short ranges; this system, however, has one drawback, which is that the smooth-bore gun does not impart rotation to the projectile. I have found that a projectile proceeding at 1,800 feet initial velocity without rotation is not so powerful against armour as one with 1,600 feet initial velocity, and 200 feet of rotation. If velocity of rotation is imparted to the projectile, the initial velocity is reduced in exact proportion. A projectile proceeding at 1,800 feet initial velocity from the gun will destroy itself upon the target, whilst one with 1,600 feet initial velocity and 200 feet of rotation will pass through it. This shot (pointing to one on the table) at the first moment of impact thickened an inch more than its present diameter at the front, its high spin in passing through the plate rolled it together in its present form; there is no steel shot in the same state of preservation fired from any other system of guns through a plate of its own diameter.

Commander Dawson, R.N.: Will you be good enough to explain what causes the spin of your shot? I do not quite understand the reason of it.

Mr. Mackay: The reason of the spin in the first place, is the resistance of the

air in the gun in front of the projectile, together with the revolving explosive charge at its base when the powder is ignited. If you enquire why the projectile does not proceed from the gun at the velocity of the gases, I answer, that less the velocity at which the projectile proceeds, including its gravity, the resistance in front is equal to the pressure of the explosive charge at its base. I have seen this pressure stated in the "Mechanics' Magazine" to be 180,000 lbs. to the square inch. What happens is this, that the greatest force or pressure when the explosion takes place is first on the breech, next on the cross section of the bore, so that with a judicious preponderance of space in the grooves, it would be impossible to divert the gases along the chase from a rotary to a longitudinal course, the current, therefore, takes the grooves as perfectly as the tool which cut them.

Commander DAWSON: What causes the shot to rotate? Do you mean that the grooves cause it to rotate?

Mr. MACKAY: The grooves cause the rotation.

Commander DAWSON: By the intervention of the wad?

Mr. MACKAY: The wad would not cause the rotation without the explosive force.

Commander DAWSON: Is the rotation caused by the wad being driven up into the grooves?

Mr. MACKAY: I put the wad there as a substitute for powder. I put sawdust here (pointing to the part). Powder is made of chemical ingredients which will scour the chase of the bore. I prefer using sawdust there, because it is smooth and lubricates the gun, and allows the projectile to roll in its midst, by which rolling it takes the mean of rotation due to its initial velocity.

The CHAIRMAN: Your wad does the work that the studs would do in a rifled gun. We do not quite understand what it is that makes the shot rotate, is it your wad being squeezed into the grooves?

Mr. MACKAY: Not at all. It is the revolution of the charge, which I will proceed to explain. I spoke about the cross section force being greater than the longitudinal force; the cross section force is greater than the longitudinal force, the consequence is that the whole charge revolves, communicating its revolution to the shot, the gases running along, force the sawdust up in its front, which is more suitable for the purpose than powder, and less destructive to the gun; by these means rotation is obtained. Then you get rotation in another way. I said there was a pressure of air in front. This shot, if it was not for the air, would come out of the gun as quickly as the gases, less its own gravity and velocity.

Commander DAWSON: It appears to me that the same effect would take place in any gun if the conditions you have explained are correct. What I do not understand from your explanation is this: What is the peculiarity in your gun that causes the shot to spin?

Mr. MACKAY: The pitch of the grooves, and the manner in which the grooves are put into the gun, the preponderance of force—the explosion is made rotary instead of longitudinal.

Admiral ASTLEY COOPER KEY, C.B.: I should like to ask you a question. Have you ever tried to fire that form of shot without a wad?

Mr. MACKAY: Yes, I have. I can fire them as well without, as with; but it requires a different modification. The sawdust is merely put there as an improvement upon the extra charge of powder which does not consume. I have said in the paper just read, that no shooting can be perfect unless the projectile is packed out at the muzzle of the gun. You must not allow the gases to get in front during its passage out to the muzzle. I substitute sawdust for powder to prevent this.

Admiral KEY: I cannot help thinking that that quantity of sawdust between the powder and the shot must stop the gases passing over the shot. If you apply a paper wad to any shot without studs in our service guns, you nearly stop the whole of the gas from passing over the shot. Yet you can get with three grooves a certain amount of rotation.

Mr. MACKAY: Yet it would not strike with half the force of this shot.

Admiral KEY: Because there are only three grooves, and there is only a certain amount of rotation. But I agree with you it is a great advantage, if we

can succeed in firing shots from our guns without studs—there is no question of that. Still all the advantages are not on one side. You cannot attain the advantage you offer, without at the same time losing certain qualities that our service guns now have. In the first place, the great difficulty in regard to the endurance of our service guns is the being compelled to carry the grooving down to the powder chamber. By placing the studs very far forward, the grooving of the gun need only be carried down as far as the studs of the shot, as it lies in the bore. But in your system you are compelled to carry the grooves right into the powder-chamber. That is the weakest part of the gun; and that is the point where we find all the guns fail—in the powder-chamber itself. Certainly, even if you have all the advantages you claim, you would require to modify that point considerably in guns for the Service, on account of the weakness of the powder-chamber. I would also say that although the account you have given of the accuracy of the gun is very satisfactory, I have never heard it before,—striking, I think you said, twelve times out of fifteen, a target 9 feet square, at 1,000 yards, with a 12-pounder; in your gun you had very reduced windage, which could not be had in the service gun. I doubt whether with that system of rifling, it would be possible to get the accuracy that we must have in the service gun; and for this reason: The wad compressed against and passing the shot gives rotation to the shot, and that holds the shot at the base only, therefore the body of the shot and the point of the shot must have this "wabbling" motion which you complain of so much in the practice from our service guns. It must have this "wabbling" motion, if it is only held at the base. And as it leaves the muzzle, it must have a tendency to drop. I doubt whether you can ever get sufficient accuracy with large guns, if you allow the windage that we must have in our service guns. I would also say with regard to the penetration of the shot, that all your trials, as far as I have seen them, or as far as we have heard of them, have been against unbacked plates. There is no doubt that the hemispherical head or the flat head is nearly as good against unbacked plates as pointed shot; but when you come to fire against backed plates, or a ship's side, the advantages of the pointed shot are very remarkable. I do not think there is any question about that. The pointed shot have a great superiority in penetration. I would also say a word with regard to the penetrating power that you claim for your gun. I think the 6-inch gun,* weighing 9 tons, penetrated a 6-inch plate at 75 yards, a 6½-ton Woolwich gun penetrates a 7-inch plate, that is an inch thicker, at the same range with 15 lbs. of powder,—which is only two-thirds of its full charge.

Mr. Mackay: A 9-inch bore.

Admiral Key: A 7-inch bore. That 6½-ton gun will penetrate a 7-inch plate at 70 yards. I acknowledge the great advantage that we shall gain, if we can do away with the studs from our shot. Still there are several points that you will have to clear up before you can be satisfied that it will be introduced into our Service. One great point is, that objection to carrying the grooves into the powder chamber.

Admiral Ryder: Will you tell us presently whether you have fired any of your guns to destruction?

Mr. Mackay: No. I have here a cast of a gun which fired 1,380 rounds.

Captain Burgess: With what charge?

Mr. Mackay: There were a variety of charges, some 4 lb. charges, some 3½ lbs., some 3 lbs., but generally 2 lb. charges.

Captain Burgess: What weight of shot?

Mr. Mackay: 12-pounder shot. Talking about windage in the service gun there is only $\frac{1}{100}$ths of an inch between the bottom of the grooves in the bore, and the diameter over the studs in the shot whilst there is the $\frac{8}{100}$ths of an inch difference between the body of the shot and the bore of the gun. My smooth shot must be

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* Admiral Key has overlooked the fact that my 6-inch gun penetrated through the "Agincourt" iron-plated target, a fac-simile of the ship, range 75 yards, charge 22 lbs., weight of shot 82 lbs.—J. M., 30th July, 1868.

more practical with $\frac{5}{100}$ths of an inch longitudinal windage, than the studded shot with $\frac{8}{100}$ths of an inch of working windage on the studs.

Admiral KEY: The reason why we are compelled to give a certain amount of windage over the body of the shot, on board ship especially, is because paint, dirt, and rough things of that sort stick on the body of the shot, and we cannot do with less than $\frac{7}{100}$ths or $\frac{8}{100}$ths of an inch windage on that account. It is not so much on account of the stud.

Mr. MACKAY: The effect of the service system of windage is to raise the shot $\frac{8}{100}$ths of an inch off the bottom of the bore, so that, in point of fact, the working windage space is only $\frac{8}{100}$ths of an inch. My smooth-bore projectile would be more serviceable, more practical without a doubt; my shot, as I explained in the paper, rests in the grooves, showing the windage on its upper portion. I am convinced when paying regard to the requirements of the times, the advancement in science, and the safety of the artilleryman, that it would be found impossible to continue these two diameters in the service gun in actual practice. With regard to the grooves in my system passing down to the breech of the gun, which may or may not be the case, instead, in my opinion, of being detrimental to its strength, I think it far otherwise. I will endeavour to explain my reasons. If a workman is driving a bolt into the keelson of a ship, he requires to be particularly careful to strike the bolt fair on end; it requires the most skilled workman to perform this; if, in striking the bolt unfairly, the hammer trips and the bolt is not moved, I compare this operation to that of the explosive gases on the chase of the bore, because when the charge is ignited, the gases running up those quick grooves roll the force upon every angle of the metal, thus preventing that straight blow which is given in the smooth-bore and rifled guns. I am convinced that with two 68-pounders of the same metal, the one grooved on my system, and the other left smooth-bore, it would be found that the grooved gun would discharge many more rounds than the smooth-bore without injury. In the service rifled gun where the preponderance of force is longitudinal, the gases running onwards, cut the grooves; you can see how perfect my model is after firing 1,300 rounds of shot. I do not think that firing has altered the position of those grooves the slightest particle.

Admiral KEY: With what charge were they fired?

Mr. MACKAY: I fired a great many 4lb., 3lb., 2lb. 10oz., and 2lb.; sometimes $1\frac{1}{2}$lb. charges. This is the muzzle taken off, after firing 1,100 rounds.

Admiral RYDER: Is the gun in existence now?

Mr. MACKAY: Oh, yes. Now here is a shot for a smooth-bore gun, there is not a ship afloat or a ship that can be built that will stand it for an instant. There is no ship that you can build that it would not smash.

Major-General BOILEAU: Before this discussion closes I wish to address a few words to you on the subject. It is a very interesting paper which it has been my great privilege and pleasure to read. I am sure it must be very disheartening to an inventor whose first experiments were tried more than five years ago to know that five years' progress has only brought him to the reading of a paper before the United Service Institution. Setting aside various points of detail which Mr. Mackay has referred to in his paper, and which do not appear to me to require notice in discussion, the principle of the gun certainly has something in it very attractive as well as very novel. That there must be a great rotary effect produced upon the shot by the action of the powder in the grooves, I believe has been convincingly proved by the experiments which were conducted on Crossley Sands: although they were against plates not backed, still they were against plates of considerable thickness, and the effect of the shot was to penetrate in almost every instance. There is a report of them in the "Mechanics' Magazine" of October, 1867, which contained pretty much the same results as have been described in the paper. With regard to the shape of the shot, of course it will be presumption on my part, or indeed on the part of any mere reader of artillery experiments, to offer an opinion in opposition to what has fallen from the gallant Officer who has informed us of the relative advantages of hemispherical heavy shot and pointed heavy shot. There has been a controversy on this point for many years. Mr. Whitworth considers that flat-headed are the proper kind of shot for penetrating armour plating, and his steel shot had flat heads.

Major Palliser has adopted the ogival-headed shot, and the success of that has been very great. But I think Major Palliser told us here, and we have some shot in the Museum which to a certain extent corroborate what Mr. Mackay has said, that whether it is the vibration of the shot, or whether it is the length of the cylindrical portion of it, the body of the shot in many cases broke, so there is in that something in what Mr. Mackay has observed. But as regards the paper that has been read this evening, I consider it more in respect of the principle which Mr. Mackay advocates, that is the rotating of the shot by the movement of the exploding gas along the grooves, and giving the shot rotation. By that means he does away with the studs, and it is this which makes his paper interesting, and renders it worthy of study. I do hope that among the inventions which have been brought forward, and which have failed to produce appreciation in the mind of those who have to manage these affairs, Mr. Mackay may have a chance of further experiments, and that his gun may be either worked to death, or proved that it is capable of resisting the modern trials to which guns are now subjected by the Committee of which General Lefroy is Chairman. As a mechanician there is something very winning to me in Mr. Mackay's system. Of course, until it has stood the test of experiment, the question is simply a question of opinion. But I think it has certainly passed out of the category of opinion, and has become a matter of fact, and that it will receive further experiments, which will either confirm the views of the lecturer, or make it a thing of the past like many other inventions that have been brought before us.

The CHAIRMAN: We shall be all ready to give our thanks to Mr. Mackay for the paper he has brought before us. I am sorry it has not been so fully discussed, as I have heard the subject of guns discussed in this theatre; and I trust, that if experiments are wanting, those who have charge of these trials will give Mr. Mackay a chance of trying this gun. He has certainly one element of success: that is, he has the greatest possible confidence in it. I trust that, for his sake, his confidence will not be misplaced. We are delighted always to find members discussing these matters. I think it is doubly important that officers, who, from their official position, and from the long experience they have had of all the recent experiments, as my friend Admiral Cooper Key has had, are qualified to give opinions, should come here and assist us in our discussions, and place before us facts and statements that really have weight, and must carry serious conviction to those who are interested in these subjects. I think it is of vital importance to this Institution that men in the Admiralty, and who really have the opportunity of knowing what has been done, and is being done in these matters, should come here and tell us all they know about them, as far as their official positions will allow them to do so.

I will now call upon Captain Colomb and Captain Bolton to exhibit their new signal lights.

SIGNAL LIGHTS OF CAPTAINS COLOMB AND BOLTON.

By Commander P. H. COLOMB, R.N.

Commander COLOMB: I consider myself fortunate in having had a shorter paper and a shorter discussion than usual to precede me. It is a matter of congratulation to me, though I think it is hardly so to the subject which has just been discussed. To-night I purpose showing you some of the latest developments of the "flashing signal" system. That system is now pretty well known. It was first made public in this Institution, and I then stated, and it is quite proper that I should again state it, that like most other inventions it was not, when it came into Captain Bolton's and my hands, entirely original. That is to say, other gentlemen before us had hit upon the germs of the system, although it had never been carried into practice until we took it up, and probably never

would have been. Thus Mr. Goldsworth Gurney had the idea floating in his mind as far back as 1832. Mr. Babbage, about 12 years ago, carried out a great many experiments with flashing signals, and really did understand the question—understood what was really wanted; and had he been in a position to have carried it out, would probably have succeeded in it, as we have since done. As regards the lights which I am going to show you to-night, we have them in two or three forms, for different purposes. I wish to describe to you in as few words as I can the history of the light; how it came to be devised. A short time ago there was exhibited in this Institution a light, which is known by the name of the "Spakowski light;" that light was known to me in process of invention before it came to England. It was the invention of a Russian Officer; and it was suggested to me that I should stop some experiments that I was carrying out on something the same principle, because that Russian Officer was himself at work upon the point. I sent him a message to say that I would cease, and I did cease, on the understanding, as I thought, that when he had completed the light, he would communicate further with me upon the subject. However, he did not, and the first I saw of the light afterwards, was its exhibition in England. I saw it once before it was exhibited in this Institution, and I may say that I felt, and Captain Bolton felt, somewhat dispirited with regard to that light, and for two reasons, firstly, because the light was not our own light, and I believe, generally speaking, people are not very fond of things not their own that come across their path; and secondly, and principally, I believe, because we were afraid that, if a light connected with more or less apparatus came into the hands of any person who did not thoroughly understand the question of signals, the system we had built up with so much care, and, I may say, carried out with so much anxiety in its early days, might be destroyed by the ignorance of those into whose hands it might ultimately fall; for although the system has been now working between seven and eight years, it is not still quite on a satisfactory basis, that is to say it is still comparatively new, and people are not quite certain as to the little points of detail with which it is to be carried out. We often find people supposing that things can be done with it which cannot be done; and we were afraid that if by means of a new light, the system were taken out of our hands, it would ultimately fall through. We had therefore to set ourselves to work to devise a light which should simply beat it. We had, of course, to carry out a great many experiments with various other lights, the electric light, the lime light, the oxy-calcium light. None of these lights, however, satisfied us. The lime light was found by Captain Bolton to be the best for distant signals; there is no light that comes up to it for range, no light so practicable for extreme ranges. We had no choice as we stood, between the lime light, which has an extreme range of 20 miles, and the oil light, which has only a range of 6 miles in clear weather. We wanted some light, which should be between the two, which should give us a good light, equal to 12 or 15 miles on occasion, but which might not be so generally used at such long ranges, but would be more often, should the state of the atmosphere be such as to make pene-

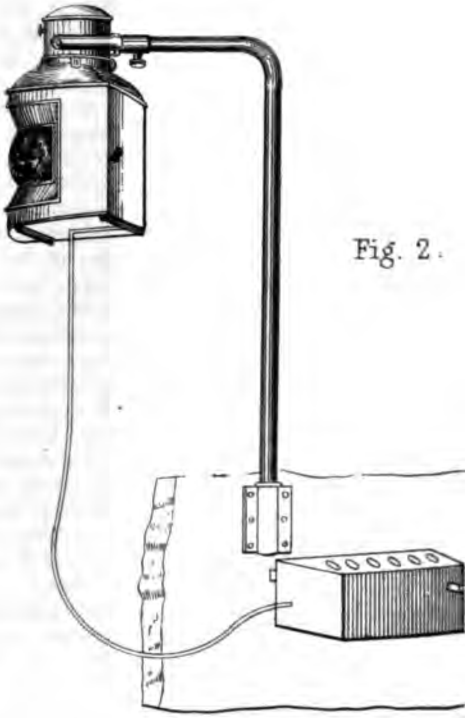


Fig. 2.

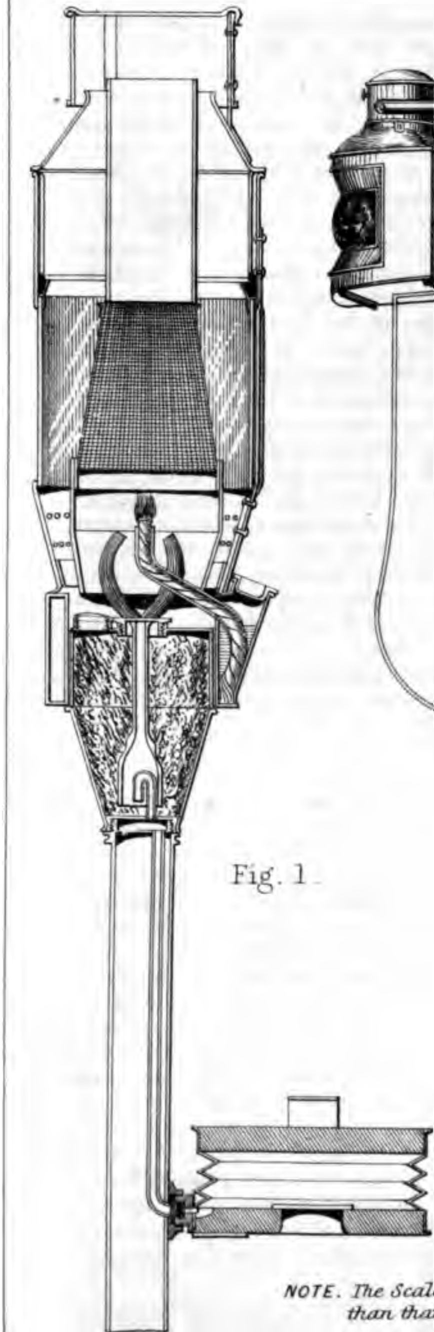


Fig. 1.

Fig. 3.

NOTE. The Scale of Fig. 1 is larger than that of Figs 2 and 3.

tration by a weaker light impossible. I had thought so much over the means of making such a light as we wanted, that I was myself inclined to desert the cause; but Captain Bolton was not quite so ready; he said, "Surely, if we put our heads together, we shall be able to devise "in the course of a very little time, some light that will do what we "want." As we were walking together and arguing the point, as we had done a good many times before, he said, "Why not try what they "make lightning with at the theatres—why not try resin?" We tried it, and in the course of six weeks we completed the light which I am now about to show you. I may mention that a number of these lights (Captain Colomb here exhibited the light) were sent out to Abyssinia, and we believe were constantly used during the whole of the campaign.

Mr. Sterling Lacon: For how long is that light charged?

Captain Colomb: That light, as it stands, is charged for about a week's ordinary work. The way in which that light is produced is very simple indeed. Any impalpable powder may be burned in it, so long as the powder is not explosive. It must be a powder which is inflammable, so long as it does not make its own oxygen. Coal dust, resin, potassium, or magnesium, or any light powder which is inflammable, may be burned. The way the lamp is arranged is as follows:—(Fig. 1.) There is an outer casing and an inner chamber which terminates in a narrow neck, then splits into two or three shoots, so constructed as to throw the powder issuing from them on to a central point. The outer chamber is filled, through this orifice, with the powder you intend to burn, but leaves the inner chamber full of air only. Through the bottom of the outer chamber comes up an air tube, the muzzle of which is bent downwards. When you force a jet of air through the tube it is deflected and plays upon the surface of the powder in the outer chamber, it just slightly disturbs it, and fills what was before filled only with air, with a light powder in suspension. Now the two or three orifices—three we find best—are much larger in area than the entrance of the air-pipe, the consequence is, that the air comes in through that entrance in a sharp jet, but issues through the pipes slowly and gently, bearing with it the powder in suspension. Here is the flame of a spirit lamp, and the moment a pressure of air is brought through the pipe, it plays on the flame and you get your light.

I will now show you some of the ingredients that may be burned. The composition we prefer to burn is composed of resin, lycopodium, which is the seed of a moss, and magnesium. You make the light more or less brilliant according to the quantity of magnesium you put into it. This signal light has one great advantage which we did not look for when we commenced our operations, but which we find now most useful, viz., that you can have in the same lamp just the range you like. You have only to alter the composition and put in stronger or weaker composition to get a greater or less range, so you need never have an expensive light for a limited range. In a fleet, for instance, the rear ships may burn a composition which will cost them perhaps half-a-crown an hour if they are constantly signalling. The ships nearer to the flag-ship, the leaders and those close astern of the flag-ship, will perhaps burn a composition that will cost sixpence or eightpence an

hour. In thick weather, again, you would burn a composition which would cost you probably three shillings an hour.

I will now burn some of the different ingredients in these little lamps that I have had made for experiments. This powder is simply powdered resin. The principle of the lamps is exactly the same as that of the larger ones, only there is one jet instead of two. This that I am now burning is lycopodium. It does not give much light, but it assists the composition, and is a good diluting power. We will now take some of the weaker powder. This we call the "Chatham powder;" and we call the light the "Chatham light," because it was while we were engaged at Chatham that we brought it out. This again is some of the stronger composition; there is there a little magnesium, a little lycopodium, and a little resin in it. First, we tried plain resin; then plain magnesium: then we came to this mixture. You may make it as strong as you like, so long as you do not burn pure magnesium. The difficulty with it is, that it is a little too inflammable. The light is very brilliant, but the composition is a trifle too inflammable. There is this danger with it, that if a spark did fall down—I do not say it would, still it might—if a spark did fall into the powder in the lamp, the powder would be liable to catch fire with the next blast of air that went in. It would not explode, but it would destroy the lamp, but that is all that would happen; the powder burns with a very fierce flame when a jet of air is thrown upon it. This (see Fig. 3), is another form of the lamp, and is intended for fixed stations. The light is only in one direction. It is of course very strong, and you see that it is quite under command. The working of it is very easy, that you can work it in fact with your finger, and yet get the full power. That is the light which I believe will be adopted for fixed stations. It is the best that we can get, it is the cheapest and the most powerful, with the exception of the lime light. This lamp weighs 5 lbs., and costs about 10 guineas; it carries in it as it stands, provender for a month. The last thing we had to attack was to give the mechanical arrangement for naval signals (Fig. 2); because although on shore we dispense almost entirely with mechanical arrangements, yet the more we have gone into the question, the more satisfied have both Captain Bolton and myself become, that although on board ship the system of flashing signals at night was not likely to fall through, still it would become discredited when communications had to be made to a number of points, such as the ships of a fleet, unless we had some sort of mechanical appliance to assist the repetition, and at regulated intervals. We have always found it impossible to get any man—no matter the amount of training that we have been able to give him—continually to measure intervals, as a revolving light-house gives them; and unless the whole of the flashings and signals are measured—as a revolving light would measure them—any observer is apt to lose part of the signal just at the moment he wants to read it. His eye gets tired, and he waits for a repetition, which does not come, because the other man is hoping that somebody else is giving an answer, and he does not go on steadily repeating the signal so as to assist him. This light before us is somewhat rough still, but I believe

that we shall be able to get the ship apparatus in very nearly the same form as the present ship lamp. I also believe that we shall be able to get the whole light a good deal under the cost of the present apparatus, although we shall have a light of twenty or thirty times the power. (Captain Colomb then made bright flashing signals for Nos. 2,442 and for 7,890.)

General BOILEAU: The bellows nozzle keeps the air-chamber full?

Captain COLOMB: The air-chamber keeps full of itself; the powder being a powder and not a liquid it does not flow up into the air-chamber.

Admiral KEY: But if you carry or shake the lamp about, is there no chance of the powder filling the air pipe?

Captain COLOMB: We have never found it do so, but should it so happen you have nothing to do but to empty it.

Admiral KEY: But you would not find it out till you began to signal?

Captain COLOMB: We have never found it so; of course if you turn the lamp upside down you would not probably be able to signal for two or three minutes afterwards. And you might get obstructions in the pipes; it is not likely that you would, but sometimes you might.

The CHAIRMAN: Has that apparatus been tried at sea?

Captain COLOMB: Not the apparatus; the light has been tried.

Mr. Sterling LACON: You have shown us three different materials, and you have also shown us the instrument charged for a week. What would be the cost of charging the instrument for a week with the three different materials?

Captain COLOMB: I am afraid that that would be rather a matter of calculation, but you can take it in this way—the composition of this lamp, the bright composition, costs about 2*s*. an hour for ordinary signalling; I suppose you would get four hours' signalling for a week. When I say for a week, I suppose you get about four hours' signalling in a night—that is rather a large amount; the cost of that is about 2*s*. an hour. This weaker composition that I showed you costs about 8*d*. an hour.

Captain BURGESS: How many signals can you make in a minute?

Captain COLOMB: You get about one signal or two words per minute, or sixty signals an hour.

Captain DAWSON: Which are the lamps that have been taken to Abyssinia?

Captain COLOMB: This one (showing the lamp). In Abyssinia the signals are made in the day time by means of flags, by waving flags from right to left, and it was necessary to provide in the simplest way we could a flag-staff for the signal lights. The flag goes on the top of the lamp; the signal-man waves his flag thus (showing the short flash), and completely down for the long flash; this plan is visible with a good telescope at a considerable distance, and is very rapid; it is the most efficient means of signalling in the day time on land that we have been able to devise.

Admiral KEY: What is the size of the flag used in Abyssinia?

Captain COLOMB: About 4 feet 6 inches, but I believe we shall reduce it to 3 feet square.

Captain BOLTON: Three feet square will give a range of ten miles with good glasses.

A MEMBER: What are the colours of the flags?

Captain COLOMB: The flags are of three colours—all black, all white, and black and white diagonally. The signalman on taking up his position by means of pointers, if he has the sky behind him as a back-ground, uses the black flag; if he has trees or rocks, or anything that will form a dark back-ground, he uses the white flag; if it be a doubtful back-ground, he uses the white and black flag, which is seen against any back-ground.

The CHAIRMAN: We all, I am sure, return our best thanks to Captain Colomb and Captain Bolton, for we rarely, I think, see a device so complete as this apparatus appears to be, so ingeniously put together, and so clearly explained.

Evening Meeting.

Monday, June 15th, 1868.

MAJOR-GENERAL J. T. BOILEAU, R.E., F.R.S., in the Chair.

NAMES of MEMBERS who joined the Institution between the 1st and 15th June, 1868.

LIFE.

Meade, Hon. Herbert, Lieut. R.N. 9*l*.

ANNUAL.

Trevelyan, Sir Charles E., K.C.B., late Governor of Madras. 1*l*.
Parry, Richard, Cornet late 2nd Roy. N.B. Drags. 1*l*.

THE CONSTRUCTION OF HEAVY RIFLED ORDNANCE.

By Major W. PALLISER, Unattached, late 18th Hussars.

THE last time I had the honour of reading a paper in this Institution, I described two separate methods of constructing guns composed of a combination of cast and wrought iron.

The first of these related to the insertion of strong barrels of wrought iron into cast-iron casings, the second to casting casings of molten metal round wrought-iron barrels placed in a mould.

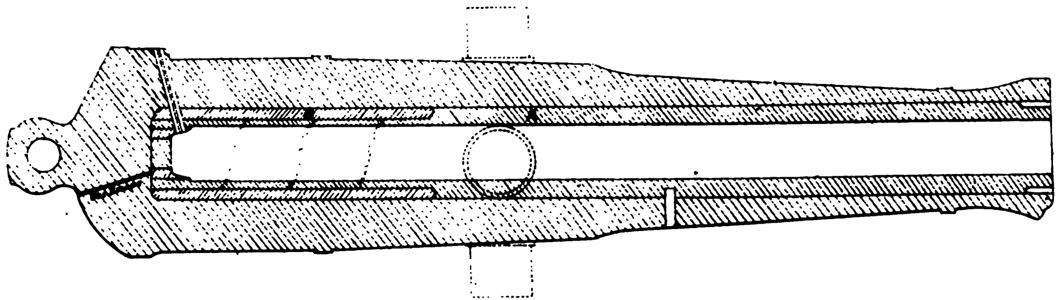
The first of these plans has since the date of that lecture proved successful, and has been definitely adopted into the Service, with a view of converting all the heavier natures of cast-iron smooth-bore guns into rifled cannon suited to the requirements of modern warfare. I have also found out by experiment since the above date, that the latter plan, namely that of casting the hot metal round the barrels, is not practical for producing compound guns on a large scale.

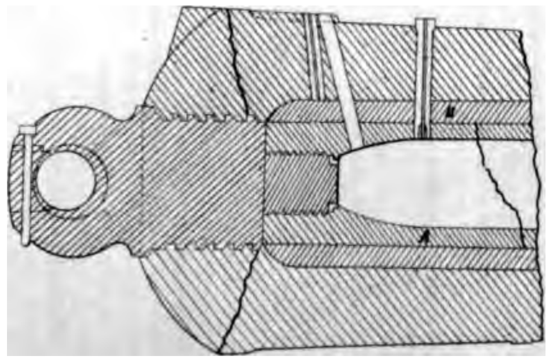
I shall, in the first place, make a few remarks upon the latter plan, with a view of explaining why the process itself of this mode of manufacture produces bad, or at all events uncertain results, and also to point out the valuable information that has been obtained by the trial of one heavy gun which was made in this manner.

At the date of my former paper that gun, a 9-inch rifled gun of 12½ tons, had fired 111 rounds, of 43lbs. of powder, and 250lb. shot.

I stated in my paper that "the coils which form the second length "at the breech end of the barrel were imperfectly welded, and, in con- "sequence, were separated one from another."

Cast Iron Smooth bore, Converted on Palliser's principle into a Rifled Gun.





No. 247 68 Pr of 95 Cwt. condemned after 373 rounds for fissures round the vent lined 1864 in R.G.F. with a double coiled tube, the A or inner tube of soft iron, the B or exterior tube of harder iron, calibre 7in. It completed 800 rounds, when the A tube split longitudinally. It was then relined as above and blew the breech out 6th April 1866, min 18,540, after 103 rounds, of which 83 with the full battering charge of a 7inch 7ton gun. The breech cracked at 102nd round of 2nd series The tube did not break until the last round.

(Signed) J H. Lefroy,
Brigr General R.A
Pres O S C

J Johns

In evidence which I had occasion to give before the Ordnance Select Committee on the 13th December last, alluding to the same gun, whose trial at that time had not been proceeded with, I said, in answer to question 240—" If marks of this sort were found in the gun close to " the powder chamber I should reject it. . . . .

" I should reject the gun because, although I do not consider they " interfere with the gun's strength, yet I think such marks as that " would lead to distrust amongst Officers abroad, who were not " thoroughly up to the matter, who, in fact, have not the same " practical experience of testing by continuous firing guns with similar " marks in their coiled tubes." . . .

Since the date of that evidence, the gun has completed its test of 511 rounds with battering charges.* The hollow screw collar at the muzzle, which is a peculiar feature of my plan of conversion, was omitted in this gun. It also happened that the barrel was very loose in the chase of the gun. The repeated vibrations of the very heavy charges cracked the barrel at the muzzle; the cracked portion expanded up against the cast iron surrounding it, and no further ill effects ensued. The accident served to prove to my mind the necessity for having a screw collar at the muzzle; the interior of this collar, as you will observe, is slightly rounded out. The effect of the pressure of heavy charges upon the barrel, is to compress the metal round the charge, and consequently to squeeze the tube out at the muzzle, much in the same way that moist colours are squeezed out of the small metal bags in which they are usually contained; when, however, a screw collar is employed, the tube becomes jammed into the rounded interior, and thus all vibration is checked. In no case in which the screw collar has been employed, has the barrel cracked at the muzzle.

Although I do not intend to persevere in the plan of making heavy guns by casting the hot metal round the barrels, I think I can shew that the cost of firing the 9-inch gun, has been money well expended. In the first place the rifling in that gun was not carried down into the powder chamber, whereas, in a wrought-iron 9-inch gun, lined with a similar barrel, and rifled with similar grooves, the rifling was carried down to the powder chamber. In the latter gun the barrel began to split at an early stage of the experiment, and was completely split through when the programme was about half finished.

* "Since the date of this report, 9-inch gun No. 293, made with a coiled iron barrel, double at the breech end, with a cast-iron exterior (cast round the tube) has completed 511 rounds, viz. :—

" In smooth bore state—

Charge, 55 lbs.	Shot, 250 lbs...	..	..	2
,, 43 lbs.	,, 250 lbs...	..	..	18

" After rifling—

Charge, 55 lbs.	Shot, 250 lbs...	..	..	2
,, 45 lbs.	,, 250 lbs...	..	..	87
,, 43 lbs.	,, 250 lbs...	..	..	402
				511

"The tube has split from the muzzle about half its length down, and was in this condition during a large part of the test."—Ordnance Select Committee Report, No. 4,888, Jan. 29, 1868, page 12.—20th July, W. P.

The former gun (namely, my gun) completed the 500 rounds without splitting the barrel down the powder chamber.

The charges of both guns were alike, and were fired in the same manner, and thus a conclusive proof of the value of a smooth bored powder chamber was obtained.

2. All 9-inch guns that had previously been fired, required re-venting after a limited number of rounds. The vent of my gun was fitted in a peculiar manner with Messrs. Johnson and Mathey's alloy of platinum, and completed the 500 rounds without receiving a new vent, thus confirming the trial of my 7-inch gun, converted from a 68-pounder, which in 1865 fired 800 rounds without requiring a new vent.

3. In my previous lecture, I stated that "every way of regarding the " subject shews that the circumferential strength should be applied " internally, and that the longitudinal strength should be borne by the " outside. And this is precisely the reverse of the principle on which " the wrought-iron guns of the service are made."

The trial of this gun has since conclusively proved the truth of that remark. I have already shewn that the interior coils were separated, and, therefore, it follows that no longitudinal strength could be conferred by the barrel.

A wrought-iron gun, No. 287, burst into two pieces at the 104th round on the 25th July, 1865.—(See War Office Parliamentary Return, April 18th, 1866.) The cause of this failure was that the gun was nearly bisected in rear of the trunnions, where the thick breech coil met the trunnion ring. The uniformity of longitudinal strength was in this manner destroyed; the absolute necessity for this uniformity was not, even at that late date, understood. The blame, however, was laid upon a circumferential flaw in the barrel. However, in the second gun, turned out at the same time, the real defect was remedied by removing the breech coil and hooking it over the trunnion coil. This gun, however, burst with violence at the 368th round.

A 10-inch gun at Shoeburyness, blew its breech out about a year ago, when the blame was again laid upon a defective weld in the coiled tube. This gun, however, was one that was made before my proposal relative to the mode of closing the breech of wrought-iron guns was adopted. The barrel had been introduced from the rear, and the gun had necessarily a *minus* screw thread in the breech. Notwithstanding that it had a longitudinally forged solid breech-piece, the breech was blown out, the metal parting round the innermost turn of the female screw thread, as though it had been cut with a knife. Again, on the 12th November, 1867, I wrote to the Select Committee, stating that I had observed in the *Times* of that day that a 12-ton gun on board H.M.S. "Wyvern," was stated to have blown its breech out. I said, " If such be the case, I feel confident the gun must be one of those " made before my proposal as to the screw breech was adopted, and that " it would be found that the metal had parted round the innermost turn " of the female screw-thread." My conjecture subsequently proved to be absolutely correct. My proposal ever since the year 1862 had been to substitute a stout coil next to the A-tube, instead of the solid

forged breech pieces, in order to prevent explosive bursting when the inner barrel became split. My 7-inch gun of 1864 had such a tube in it, and, in consequence, it fired 50 rounds without further injury after the tube split. It is evident, therefore, that the Superintendent of the Royal Gun Factory had forgotten this fact, when he stated (in reply to Question 63 of the Report of the Ordnance Select Committee, already referred to), "in connection with cast-iron you lose one advantage, "because if your tube goes, you have a treacherous metal outside." I now assert as a fact, that all the wrought-iron 9-inch guns which had solid forged breech-pieces round their inner barrels, have burst with violence into pieces, within a very few rounds after their inner tube had split; the reason is that the solid forged breech-piece possesses no circumferential strength, and the outer coils, in consequence of this very breech-piece, are too far off to prevent disruption with violence, after the barrel has split; for, owing to their position, the force of the powder possesses a great mechanical advantage over the resistance opposed by the outer coils. If thus it has been conclusively proved that *outer* coils are incapable of preventing violent disruption, I ask what advantage do they possess over cast iron?*

The trial of my 9-inch gun which commenced on the 5th September 1866, proved that the solid forged breech-piece was unnecessary for longitudinal strength, so long as the breech was closed with a *plus* screw-thread, and the barrel introduced into the casing from the muzzle, instead of, as formerly, from the breech. The solid forged breech-piece has in consequence been dispensed with in all the heavy muzzle-loading guns of the Service, with very satisfactory results. I trust I have succeeded in showing, that the trial of this gun has proved, 1stly, the value of a peculiar mode of applying platinum to the vent; 2ndly, the great value of a smooth-bore or unrifled powder chamber; and, 3rdly, that the solid forged breech-piece, so fatal to circumferential strength, was unnecessary for longitudinal strength, so long as a *coiled breech-piece* was combined with the *plus* screw-thread in the breech.

Simultaneously with the trial of this gun, I constructed two others, viz., a 12-inch gun of 18 tons weight, and another 9-inch gun, similar to the one above alluded to.

The 12-inch gun burst with violence on the first round with 100 lbs. of powder and 400 lbs. shot. On testing the fractured portions of this gun, I found that the cast iron broke at strains, ranging from 5 to 6 tons; further, that specimens, 2 inches long between the bearings, which were cut out of the wrought-iron thick-coiled breech-piece, snapped, in one instance, under a strain of only 13 tons to the square inch, and that it only stretched $\frac{1}{12}$th of an inch, whereas all the similar specimens cut from the inner or A-tube, went up to a strength of about 22½ tons, and stretched half an inch. The reason why the cast iron was so weak was, that with a view of preventing its in-

* Since writing this paper, one of the wrought-iron 9-inch 12-ton guns, lined with a steel tube, burst with violence at proof into 18 pieces, some of which were thrown to a distance of several hundred yards.—W. P., 25th November, 1868.

ternal surface from becoming chilled by contact with the wrought-iron interior tube, I had purposely selected the very softest brand of cast iron I could obtain. I was not, however, aware, until after the guns had been made, that this brand of iron would have become so weak when employed in large masses. It follows, however, that if the iron in the casing of the 9-inch gun which fired 500 battering charges, is only (as I suspect) up to a strength of 5 tons to the square inch, casings possessing the usual strength of cast-iron guns, which varies between 10½ and 12 tons to the square inch, will be quite strong enough.

The cause of the difference of strength of the wrought iron in the thick B or outer tube, and that of the inner or A-tube, is as follows:—

In casting these guns, a powerful current of air was driven through the inner barrel, and, notwithstanding the great heat and mass of the cast iron, this current sufficed to prevent the inner barrel from ever being raised beyond a red-heat.

On the other hand, the B, or outer tube, which at the breech end of the barrel was alone in contact with the molten metal, expanded away from the inner tube, and thus the continuity of conduction became broken. The B-tube in consequence, became heated over welding-heat, and the quality of the wrought-iron became thereby destroyed. To illustrate this, I would observe, that if a bar of wrought-iron be put into the fire, and raised above a welding-heat, and then suffered to cool gradually, without being hammered, the same iron which previously had possessed the strength of 23 tons to the square inch, would be found to possess only that of about 13 tons, and further, that its extensibility would have been completely destroyed.

The bursting of my 12-inch gun shook my faith in this mode of manufacture, and I determined to ascertain whether the 9-inch gun was similarly defective. I accordingly began by proving it with two rounds of 55 lbs. of powder and 350 lb. shot, instead of the service proof of 250 lb. shot. I further caused the vent to be moved forward some 10½ inches from the breech-end of the bore, and resolved to fire from it 100 proof rounds of 55 lbs. of powder and 250 lbs. shot made up in the most trying manner. The vent was advanced to the above position purposely to make the strain as great as possible. It is usual in firing all heavy guns, to make up the charges to a considerably less size than the bore of the gun, as it is found that this arrangement materially diminishes the first shock upon the gun. But in order still further to increase the strain, I made up the charges to the full size of the bore. The gun burst at the second of these rounds. The outer or B-tube split right down its entire length, the two large pieces of cast-iron, from the upper side of the gun and extending from the trunnions to the breech, were thrown, or rather fell over the sides of the carriage. The carriage, however, was not injured. No lateral explosion took place, for the inner or A-tube, which had not been damaged by the action of the heated metal in casting, did not burst.* The longitudinal support,

* This tube expanded upwards of half an inch, *i.e.*, it elongated in its circumference upwards of 1½ inches.—W. P., 25th November, 1868.

however, to the breech having been torn off its upper part, and the breech being held only by the cast-iron on its lower part, it was blown down and bounded away to the rear to the distance of thirty yards.

When it is considered that this gun was similar in all respects to the 9-inch gun, which had endured 500 battering charges, and further that it had passed the excessive proof of two rounds of 55 lbs. of powder, and 350 lbs. of shot, I think it will be admitted, that in all probability it would have gone through the test of 500 battering charges, which the sister gun had endured.

My faith in the system of casting casings round the barrels had, as I have already observed, received a severe blow by the bursting of my 12-inch gun, and, such being the case, I considered it imperative upon me to sift the matter thoroughly, and not to try and bolster up a mode of applying the general principle of construction, which the bursting of my 12-inch gun led me to think was a bad one, and I came to the conclusion in my own mind, that unless the 9-inch gun would stand 100 rounds of excessive charges, such as the above, it would not be a fit gun for me to propose for introduction into the Service.

It failed under the test, and though it is not without some feelings of regret that I now abandon a mode of manufacture upon which I had spent much time and money;* which presented such strong promise of success; and which, had it succeeded, would have enabled the heaviest cannon to have been produced at a very rapid rate, and at very low cost: still that feeling is counterbalanced by the satisfaction to myself, of knowing that the spirit in which I have conducted these experiments, has been one which renders the introduction of an inferior class of gun, impossible. I shall confine future experiments to casting large casings separately, and lining them afterwards.

I now come to that portion of my subject which relates to the conversion of existing cast-iron guns into rifled ordnance suited to the requirements of modern warfare. I am happy to say that the experiments upon *this* mode of constructing guns have led to a result very different to that just described, inasmuch as the Ordnance Select Committee, after a long and careful inquiry extending over six years have come to the following decision. I quote their words:—

"The Committee do not hesitate with these facts before them, to "recommend an extensive conversion, of our present cast-iron smooth-"bored guns, into rifled guns, with linings of coiled iron, for secondary "purposes of defence."

The recommendation of the Committee has been accepted by the authorities, and a large number of guns has been ordered for conversion. My remarks *now*, will therefore touch upon that which is the actual *materiel* of the Service, and consequently will, I trust, possess greater interest on account of the subject not being any longer speculative.

* It is right to state that the 12-inch and the 9-inch guns were made at my own cost, as well as most of the converted guns which have been experimented with, as it has been stated in the *Engineer* that these experiments were made at the public expense.—W. P., 25th November, 1868.

I would remind you, that in my lecture of last year, I explained, that the mode of converting cast-iron guns, consisted in boring up the casing and accurately fitting into it, two wrought-iron coiled barrels, one inside the other. I showed that the object of employing two thin barrels, instead of one thick one, was not for purposes of obtaining greater strength, but to break the continuity of any internal fracture that might occur. As I have frequently been asked why I prefer coiled wrought-iron barrels to steel, I will state my reasons, which are as follows:—

1st. Coiled barrels are cheaper.

2ndly. They admit of being inserted loosely into the casing, and set up inside it by heavy proof charges with absolute certainty.

3rdly. That coiled wrought-iron resists the abrasion or scoring caused by the action of the fired gunpowder, much better than steel.

4thly. The soft coiled iron barrel is more extensible than a steel one, and in stretching excites the assistance of the outer portions of the gun to a considerable extent, before internal fracture can possibly commence.

5thly. That it merely *bulges* under the premature explosion of shells in the bore of the gun, or when excessive charges are employed, while the steel barrel under the same conditions is liable to burst.

6thly. The absolute certainty of uniform strength possessed by the coiled iron barrel as compared with that of steel.

The objections against coiled barrels are as follows:—

1st. That coiled barrels are liable to circumferential flaws and bad welds, and should the barrel be not sufficiently welded, the coils are apt to separate in the powder chamber, under the action of heavy charges.

2ndly. That the coiled iron barrel possesses very little longitudinal strength.

3rdly. That the rifled grooves do not so well resist the continual wear of rifled shot in their driving edges.

I now proceed to notice the above statements in detail, and in doing so shall quote from the evidence given before the Ordnance Select Committee. Some of this evidence is of the greater weight, as it is that of Colonel Campbell, Superintendent of the Royal Gun Factories, who advocated generally the employment of steel in preference to coiled wrought-iron.*

With reference to my 1st statement, "that coiled barrels are cheaper than steel;" Question 71, Ordnance Select Committee Report.

Speaking roughly, what is the ratio of steel and coiled iron for an A-tube? Is it 3 to 2, or 2 to 1, or what?

Answer, by Colonel Campbell, Superintendent Royal Gun Factories. —"If your coiled tube was right the first time, you would make two or perhaps three coiled tubes for one steel one, depending on the size."

Question 72.—"Do you mean that you could make three coiled

* It is right to state that the introduction of Marshall's charcoal iron for making coiled barrels is due to Colonel Campbell, as he was the first person who definitely proposed this peculiar kind of wrought iron, and succeeded in *proving* its value. —W. PALLISER, 28th July, 1868.

tubes of Marshall's iron for one of steel?" Answer "Yes, for large guns."

My 2nd statement was, "that the coiled wrought-iron barrel admits of being inserted loosely into the casing, and set up inside it by heavy proof charges with absolute certainty."

My proof consists in the fact of several dozen guns having been converted and "set up" in this manner without a single failure, or any difficulty having occurred.

3rd statement—"That coiled wrought-iron resists the abrasion or scoring caused by the action of the fired gunpowder, much better than steel."

The 70-pounder Armstrong gun employed in the competitive trial with the Whitworth gun, was lined with a steel barrel. For a considerable number of rounds, wads were employed to check the escape of gas over the projectile, and thereby prevent the scoring. These wads were dispensed with at one part of the trial, and the result was, that the tube became much scored, or as it is technically termed "guttered," and the barrel cracked in the rifle groove. On the other hand a 32-pounder converted into a rifled 64-pounder gun* by means of a coiled barrel, has lately completed 2,286 rounds without wads having been used at all. The gun is but slightly scored. The last 80 rounds fired from it were with double charges of powder. Furthermore two 68-pounders† have been converted into lined 68-pounders, by means of coiled wrought-iron barrels, and have each fired 1,000 rounds with scarcely any marks whatever. Both guns are serviceable, and have been re-issued to Her Majesty's ship "Excellent."

4th statement—"The coiled wrought-iron barrel merely bulges under the premature explosion of shells in the bore of the gun, while the steel barrel under the same condition is liable to burst."

A few months since, a double shell containing 11 lbs. of powder, burst accidentally in the muzzle of a 6½ ton 7-inch wrought-iron gun, lined with a steel tube, on board the iron-clad ship "Lord Clyde," on the 29th November, 1867, and blew away the muzzle of the gun. In full knowledge of this fact, I deliberately fired five shells, each containing 12½ lbs. of powder, out of an 8-inch rifled gun, converted from an old cast-iron 10-inch shell gun, of 84 cwt. The charge employed was 22 lbs. of powder, and holes were bored through the bases of the shell. Four of the five shells burst in the inside of the gun, and the effect was merely, that the barrel was slightly bulged where each burst took place.—(See Ordnance Select Committee Report, page 7, No. 4,888.)

The same experiment had been previously made by me with a 64-pounder converted from a 32-pounder cast-iron gun, when 5 shells, each containing 4½ lbs. of powder, were intentionally burst in the bore, without any serious effects. In both cases the guns were loaded afterwards without any difficulty.—(See Ordnance Select Committee Report, as above.)

5th statement—"That the soft coiled iron barrel is more extensible than a steel one, and in stretching excites the assistance of the outer portions of the gun to a considerable extent before internal fracture can

* Experimental number, 348. † Experimental numbers, 283 and 284.

possibly commence." The 64-pounder which I have just alluded to, was tested to destruction by increasing charges, when it eventually failed by harmlessly cracking the outer casing.

The barrel in this gun was bulged a quarter of an inch. It was otherwise uninjured, and has been since placed on another casing, which has passed proof satisfactorily.

Even in the case of the 9-inch gun which burst the other day, the wrought-iron barrel has expanded to an extent of half-an-inch, without showing any signs of cracking.

6th statement—"The absolute certainty of uniform strength possessed by the coiled iron barrel as compared with that of steel."

In the year 1863 a cast-iron gun was tried with a double barrel composed of a steel tube inside another of wrought-iron, the steel barrel was tempered in oil in the manner pursued in the Royal Gun Factories. On the 29th September, 1863, I wrote to the Select Committee, *before the gun was tried*, and pointed out that I considered the steel to be too highly tempered, and that it would probably split in a few rounds. When the gun was proved, it split at the first round right down its whole length with a charge of 28 lbs. of powder, and a shot of only 68 lbs. weight. The coil tube outside the steel one kept the gun together, and prevented a burst from taking place. It is true that the barrel in question was too highly tempered, but the accident shows that slight inattention to the precise quality of the steel, or to the tempering of it, may lead to serious consequences in converted cast-iron guns, although the same contingency may not apply to steel tubes tightly bound up within super-imposed coils of iron or steel.

My opinion as regards the greater reliability of the coiled wrought-iron barrel for preventing a lateral burst, is confirmed by the replies of the Superintendent of the Royal Gun Factories, in the examination already alluded to.

Question 60 before the Select Ordnance Committee.

With reference to coiled barrels:—

Q. "You do think them unsafe?"—A. "Not if your gun is longi-"tudinally strong."

Q. 262. "But not for bursting?"—A. "For bursting. My opinion is "that they are really better than steel. As regards a bursting strain, I "would rather stand by one without a steel tube than one that had it."

And now with regard to the objections which are urged against the coiled barrels.

1st. "That coiled barrels are liable to circumferential flaws and bad welds, and should the barrel be not sufficiently welded, the coils are apt to separate in the powder chamber, under the action of heavy charges."

I have already pointed out that the wrought-iron barrel, in the 9-inch gun which fired 500 rounds, was badly welded in the powder chamber, and that the coils were in consequence separated in the firing; that I had stated, previously to the trial of the gun, that I should not have passed such a barrel into the service, but that I wished the gun to be fired in order to prove the little importance of such defects. The trial of that gun, which completed its endurance test of 43 lb. charges, with

250 lb. shot, has since proved the justice of that opinion. Further, a 32-pounder gun converted into a 64-pounder rifled gun by the Elswick Ordnance Company—one of 20 similar guns for the colony of Victoria—was rejected for having circumferential flaws in the powder chamber.

My answers to the Ordnance Select Committee with reference to this gun, and previous to its trial, were as follows:—

Q. 268. "You are aware that we are going to test two of the lined 64-pounder guns for endurance until they burst?"—A. "Yes."

Q. 269. "One of those was a gun that was rejected at proof?"—A. "Yes."

Q. 270. "You voluntarily put forward that gun to undergo this "test, from a belief that the cause for which it was rejected does not "affect its strength materially?"—A. "Yes, just so."

Q. 271. "And we may accept the results with that gun as perfectly "as if it had not been rejected?"—A. "Yes, I think so. At the same "time I should wish to state that I have not taken exception at the "gun having been rejected. I have not stated that the gun ought not "to have been rejected. My great object in firing with that gun, is to "prove of how very little importance circumferential flaws are in a "coiled barrel, rather than to seek to prove that the gun was impro-"perly rejected, because after all it is a matter of opinion as to what "constitutes a flaw for rejection."

Now that is the gun which completed as above stated, 2,286 rounds. The circumferential flaws have undergone little or no attention during trial. The last 80 rounds were with double charges, and the two wrought-iron guns of similar size with which this gun was compared, had burst with violence respectively at the 2,211th and 2,273rd rounds. Moreover, the 2nd wrought-iron gun had been repaired twice after it had fired 2,000 rounds.

The firing was discontinued with my gun in order to save unnecessary expense. The result had been so completely satisfactory, that the trial of my second gun was dispensed with altogether, as it was considered quite unnecessary. I would remark that both the wrought-iron guns were especially prepared with a view to being tested by continuous firing, whereas mine was a rejected gun out of a contract supply. I may state that the manufacturing difficulties which led to the separation of the coils have lately been completely overcome by the Elswick Ordnance Company, so much so that on a recent occasion the Ordnance Select Committee wrote to me to ask, whether the barrel in a gun which had endured an excessive test was really composed of coiled wrought-iron, because it was so perfect that they could not detect the slightest coil-mark in it. This excellence of manufacture is due partly to the experience of the Elswick Ordnance Company, and partly to the introduction by them of a new process which I may not be at liberty to explain.

2nd objection—"That the coiled barrel possesses very little longitudinal strength."

I fully admit the truth of this statement, but the leading principles in my converted guns are, to throw the longitudinal strain

on the cast iron outer casing by allowing the tube to abut against it, and to depend upon the double coil at the *inside* of the gun for the lateral or transverse strength. In my former lecture I shewed, that by transferring the total pressure of the discharge on the end of the bore of a gun to a larger area, you diminish the pressure on the square inch on the larger area, and thus increase its powers of resistance in a direct ratio. However, as facts are better than theories, I may state that of all the guns tested by me with excessive charges, in no case has the solid-ended gun blown its breech out.

Two guns which had been fitted with false cascables for experimental purposes, blew their breeches out in the manner shown in the above diagram. The barrels of both these guns were taken out and put into two other casings; one of these has fired, amongst other severe charges, 2 rounds of 37½lbs. of powder and 180lb. shot, and 60 rounds of 30lbs. of powder and 180lb. shot. When the weight of this gun (only 4½ tons) is considered, and that the battering charge of the 7-ton 7-inch rifled gun is only 22lbs. and 115lb. shot, you will be enabled to judge of the extreme severity of this test. Several wrought-iron guns, made before my proposal relative to closing the breeches of such guns had been adopted into the Service, have blown their breeches out, but no wrought-iron gun has done so, whose breech is closed in accordance with my patent.

It would be as unfair to state that such wrought iron guns are weak longitudinally because several of a previous and inefficient construction blew their breeches out, as it would be to assert that the cast iron lined guns are weak longitudinally, on account of the failure of two guns with badly patched cascables. Not only has no solid-ended converted gun of mine ever blown its breech out, but no converted gun of mine—not excepting the two above-mentioned failures—nor those guns which were tested to destruction with charges increasing in severity, has ever burst with violence, without having previously given distinct warning that its existence had come to an end.

In proof of this assertion I would state, that my two first guns were tested to destruction by cylinders increasing every 10 rounds by the weight of one round shot from 68lbs. up to 680lbs. The first gun went through the endurance test without bursting. This gun was lined with a single barrel representing the Service converted gun (which is lined with a *double* barrel) with its inner barrel removed. It became manifest at the end of the trial, that this barrel was eaten deeply into by the action of the powder firing the heavy cylinders. On the completion of the first test, I informed the Committee, July 11th, 1863, that the gun had become unserviceable, and requested leave to repair it.

My second gun was converted into a 6½-inch gun, and subjected to a similar test. At the 78th round, the inner barrel cracked under the enormous strain caused by firing cylinders upwards of 5 feet long. I thereupon wrote to the Committee, November 29th, 1863, and asked to repair this gun, too. In both cases I was refused, as the Committee were not anxious to see how much would be got out of a gun under the most favourable circumstances, but rather to ascertain its

ultimate strength by means of a crucial test. I quite concur with the opinion of the Committee, and only mention the facts to show that even these guns had given premonitory symptoms. The 6½ inch gun with a cracked tube fired two rounds with cylinders weighing 534 lbs., and burst on a third round, the weight of the cylinder being then increased to 599 lbs.

The 7-inch gun, with the patched cascable, cracked round three parts of its circumference, at the 904th round. You could have put your hand into the crack. I purposely fired another round, and blew the breech to the rear. My object was to see whether the gun would burst laterally, and this it did not do.

3rd objection—"That the rifled grooves do not so well resist the continual wear of rifled shot on their driving edges." This objection was foreseen by me from the first, and it was on this account that I proposed accelerated rifling, which reduces the pressure on the driving edges of the grooves to a minimum. It has, however, been proved, *à fortiori*, that such rifled grooves in a coiled barrel will stand the test of continuous firing. With this object, the 68-pounder, converted into a 7-inch rifle gun by means of a coiled barrel, was rifled with an accelerated spiral, with a final pitch of one turn in 28 calibres. The quickest pitch in the service being one turn in 40 calibres. That gun fired 800 rounds, and the projectiles were fitted purposely with only one stud in each groove, in order to test the resisting powers of the rifled grooves to the utmost. The result of the trial was that the grooves were worn to a certain degree, but not to any serious extent.

I will now mention a curious fact that I have lately ascertained with reference to rifling cannon. The shot at first lies on the lower surface of the bore, and the first effort of the rifling is, to lift it up, but the pressure of the gas escaping over the top, presses it down. The result of these opposing forces is, that the shot acquires an irregular motion in the gun, which leads to unsteadiness of flight and inaccuracy of practice. I admit, so far as the long shells are concerned, which are fired with comparatively small charges, that this evil does not make itself very apparent, but where short solid shot are fired with heavy battering charges, the practice becomes very wild, especially when the large amount of windage is allowed which practical Artillerymen will insist upon as a *sine quâ non*. I hence found that by rifling the gun eccentrically to the bore, and by causing the grooves to assist instead of opposing the combined effects of gravity and the escape of the gas, and thus obliging the shot to remain eccentric to the bore of the gun on its passage out, to the same extent as it was in the position in which it originally lay, the most remarkable results in accuracy have been obtained in firing, with battering charges, short chilled shot having plenty of windage. It is remarkable how completely this result differs from all previous theories, the common object of all systems of rifling having been, to centre the shot in the gun during its passage out.

In conclusion I wish to state my opinion, that before a new pattern gun is introduced into the Service, it should pass through three separate tests.

1st. The test of destruction by charges gradually increasing in severity, in order to ascertain that the ultimate strength of the gun is fully up to the required standard.

2ndly. It should endure, without injury, a moderate number of rounds—say from 50 to 100 with charges greatly in excess of anything which the gun by any possibility can be called upon to fire, in order to show that it possesses a satisfactory margin of strength to resist *repeated* severe strains without deterioration.

Lastly. The continuous firing test of the largest charges which the gun can be called upon to fire in service, in order to prove that its lasting powers are beyond doubt.

The Ordnance Select Committee state in their Report that they are not yet prepared to recommend the full battering charge of the 7-ton 7-inch wrought-iron gun for employment in the 7-inch converted 68-pounder which weighs five tons.

For the present I fully concur in their views. The 68-pounders converted into 7-inch guns, have endured most satisfactory the first and second tests above alluded to. Three of them are undergoing very satisfactorily the third or continuous test with the battering charges in question. Until, however, the third test is completed, it would be premature to assign so heavy a battering charge to the 5-ton gun.

I have of my own accord continued the tests of these guns with excessive charges, since the date of the favourable report of the Select Ordnance Committee. I am aware that in doing this I incur a certain amount of risk, for, in the event of any failure, much capital would no doubt be made of it by those who are opposed to my views; but, looking at the awful consequences which might attend. the violent bursting of a heavy gun, I would much sooner that the whole system should break down even now at the eleventh hour, than that a doubtful gun should be introduced into the Service with my name associated with it.

Captain CHARLES M. MOLONY, R.A.: The lecturer has alluded several times to Colonel Campbell, the Superintendent of the Gun Factories. As I am his assistant, and he is not present, I should like to make a few remarks upon this lecture. It is not my purpose to follow the lecturer through all he has said: I could not do it this evening, and you would not listen to me if I attempted it. But there are a few points on which I think some of the things that have been said are not justified by what is really the case. It is quite true that the Ordnance Select Committee have recommended, and that the Secretary of State for War and his Royal Highness the Commander-in-Chief have approved of these cast-iron guns being converted into rifled guns with linings of coiled iron *for secondary purposes of defence*. But that recommendation at present is limited only to guns of certain natures. I do not wish to quarrel with that. I do not say that they have come to a wrong conclusion. They have had numerous experiments, and they ought to know whether it is safe. But the lecturer has taken from that an argument in favour of a wrought-iron barrel, with a cast-iron exterior, as against a steel tube and a wrought-iron exterior. So far from that being the case, it is just the contrary. In this Report, the Ordnance Select Committee recommend that *all new guns* should be made with a steel interior and a wrought-iron exterior. The lecturer has stated that the wrought-iron tubed gun which stood 2,000 and odd rounds, was fired against two 64-pounder guns with iron barrels and wrought-iron exteriors, which burst explosively. Now I do not think that that is a fair comparison. There was no comparison at all, in fact; and the Select Committee have acknowledged there was no comparison, although it has been persist-

ently put forward as a comparison. The fact is, this gun which stood this number of rounds, and which I believe is an excellent gun, was vented far back; the two other guns were vented forward. Now nobody knows better than the lecturer does the effect of that. I could quote from one of his pamphlets a passage, in which he says, that the effect of the charge on guns vented forward is double that on guns vented back. It is not fair to say that those two guns burst explosively, and that his gun did not burst at all, unless he states that fact with regard to the venting, I have also to state, that in saying that one of those guns burst explosively, he is not correct. It did not do so; the breech merely came off; it merely shed the breech; the breech and the muzzle separated. I believe that if either of those two guns had been fired with their vents in the position in which it is in Major Palliser's gun, they would have lasted to this time. In favour of that opinion, I may refer to the Whitworth and Armstrong 64-pounder guns; they were found perfect when they were bisected, and they had steel barrels with wrought-iron exteriors. The Committee did their very best to burst them, and they were not able to do so, and they afterwards bisected them to see the result of their labours. The lecturer has taken credit for a great many things being discovered by the trials of his three heavy guns. He has told you the history of all three of them, *and they were all three failures.* The first of them failed by the bursting of the interior tube; at the 182nd round it became unserviceable. No one in his senses would think of going on with a gun when he saw a great crack on the surface extending some way down. Major Palliser states that there was a defective weld in the chamber of that gun, which showed, by the gun not bursting, that there was no want of longitudinal strength in it; that the cast-iron bore all the longitudinal strain. But that defective weld never went through the barrel, and it fired 500 rounds. I do not know what the thickness of the barrel is, but the crack is only half-an-inch in depth; the wrought-iron bore the whole of it.

The CHAIRMAN: I believe the lecturer has stated that that system is altogether abandoned?

Captain MOLONY: A large portion of the lecture has been devoted to that point.

The CHAIRMAN: Will you confine your observations to the guns that have not been abandoned?

Captain MOLONY: I do not know that I have any more remarks to make upon the subject; but as Major Palliser was on the subject of heavy wrought-iron guns, I thought I might in fairness allude to it. At all events, it has been stated that the casting of that metal round the wrought-iron deteriorated it, and some cases have been mentioned in which it was so. Now, of that very gun which burst a few days ago at Woolwich, we took a piece for testing and found it was not deteriorated.

Major PALLISER: That gun was my property, and what right had you to do that? I said one specimen cut out of the 12-inch gun broke at a strain of 13 tons per square inch, and if one part of the barrel broke, it was quite sufficient, for the strength of a chain is measured by the weakest link.

Captain MOLONY: It did not deteriorate; the real truth was that the gun was inherently weak. When they cast the metal round the wrought iron, the wrought iron was expanded out to the metal; and when the gun cooled again, the wrought iron contracted from the metal.

Major PALLISER: Did you see the gun cast?

Captain MOLONY: No, I did not. Those are the points I chiefly wish to mention. I could mention many more, only the Chairman says there is not time.

Major PALLISER: Would you allow me to reply individually, because otherwise it would be impossible to remember all the objections that have been made? First of all, the Assistant Superintendent of the Gun Factories has stated, that the recommendations of the Select Committee was limited to certain guns. I have got their Report here.

"TABULAR ABSTRACT showing the natures of the cast-iron guns recommended by "the Ordnance Select Committee to be lined and rifled. The number of each "nature mounted on works of defence in the Land Service, 1864, exclusive of India "and the number then in store, with the calibres, weights of projectile, and charge "proposed for them in their rifled state are added:"—

	68-prs. of 95 cwt.	10-inch guns of 84 cwt.	8-inch guns of 65 cwt.	32-pounders.			24-pounders.	
				63 cwt.	58 cwt.	56 cwt.	50 cwt.	48 cwt.
In the Land Service, 1864.	891	160	780	108	177	1,075	506	223
In store at Woolwich, 1865	389	141	290	18	340	338	480	478

That disposes of the statement that the recommendation of the Committee was limited to only guns of certain natures, since the heaviest cast-iron guns in the service, namely 68-pounders and 10-inch shell guns, are recommended for conversion.

Captain MOLONY: But there are no 68-pounders for this year at all events.

Major PALLISER: I took down your remarks, "the recommendation of the Select Committee was limited to certain guns." With regard to steel barrels, I distinctly said that I did not allude to a steel barrel which was bound up with super-imposed coils of wrought-iron. I alluded to steel barrels as compared with wrought-iron barrels for the purpose of converting cast-iron guns. I do not wish to enter into the discussion as to the relative merits of guns which are tied round with superimposed pieces of iron. Then, with regard to the guns converted being for the secondary purposes of defence, I distinctly stated in my lecture that the Select Committee recommended the conversion of these guns for the secondary purposes of defence. I will read what they state:—

"The Committee do not hesitate with these facts before them, to recommend an "extensive conversion of our present cast-iron, smooth-bored guns into rifled guns, "with linings of coiled iron for secondary purposes of defence. Experiments "recently made, show the possibility of controlling the recoil of a gun of only 5 tons "weight, when firing the full battering charge of the 7-inch guns of 6½ and 7 tons "upon an ordinary 68-pounder wooden platform at 5° slope, strengthened and "fitted with the American compressor, and although the Committee are not pre-"pared to recommend such large charges for lined 68-pounders, they consider "these experiments to have proved that such guns may, so far as the shock on the "carriage and platform are concerned, be used on traversing platforms with charges "beyond those appropriated to shell guns, *and therefore be included in the list of* "*guns for conversion*, with a view to their employment for harbour defence in India "or by any colonies that may desire so to utilize guns that are already colonial pro-"perty. The Committee do not recommend them for coast and harbour defence at "home, believing that, if this country is ever called upon to defend its shores, it "will be against the most powerful ships and the heaviest guns that can be pro-"duced, and that its coast defences should be of corresponding efficiency; for the "same reason, they should perhaps not enter into the armament of maritime "fortresses of the first class, such as Gibraltar, Malta, Halifax or Bermuda; but "there are probably many minor stations where they would be useful." I stated they were for secondary purposes of defence. It is not on account of their want of strength, but on account of their smallness of size that the guns were not recommended to compete with the heaviest guns that could be brought against them. With regard to the statement about the effect of the position of the vent, in the wrought-iron 64-pounders the vent entered 3½ inches from the end of the bore.

Captain MOLONY: One. The other was 6·3. One of them was 3·6, and the other 6·3. I have got a note of them with me.

Major PALLISER: Never mind; it does not matter. At all events, it is evident that whether it was 3½ or 6½ inches, it did not make much difference in the relative endurance of the two wrought-iron 64-pounders which burst. I would observe that my gun had slightly less windage than the wrought-iron guns; therefore, perhaps, a slight additional velocity would be due to that. And it was also a little bit longer, and that might also have made some difference; but not sufficient to account for this, that the initial velocity of my gun was 1,350 feet, while the initial velocity of

the wrought iron gun was 1,270 feet per second. Furthermore, the gun beat the wrought-iron gun in every manner—in endurance, in range, and in accuracy.

Captain MOLONY: Will you permit me to say that no 64-pounder of the new pattern has ever been tried for velocity at all?

Major PALLISER: What is the position of the vent of the wrought-iron gun which was tested for velocity?

Captain MOLONY: The position of the vent is back.

Major PALLISER: What, through the cup?

Captain MOLONY: Yes; at least, I believe it is.

Major PALLISER: No 64-pounder wrought-iron gun has ever been vented through the cup. I wish, however, to point out one fact, that when you employ a very long charge of powder—(I am speaking with absolute certainty about this)—then the position of the vent becomes a matter of importance, because only a certain amount of the charge is inflamed at the first instant. These two guns that we were speaking about, were fired with only small charges of powder, 8 lbs.; the position of the vent with such small charges of powder makes no difference. If you want to know the reason why my two guns lasted longer than the wrought-iron guns, I will give it you. The truth is this, that the wrought-iron guns, were rifled with very sharp grooves; and in the grooves of my gun there was a small radius taken off. That little thing formed the nucleus of the beginning of the end; the wrought-iron guns were in a worse condition with regard to their grooves, after firing 500 rounds, than my gun was after firing 2,000 rounds.

Captain MOLONY: Oh! so it was due to the rifling?

Major PALLISER: No matter; I claim that as a fact in favour of my gun. It was my own suggestion, and proved to be of great value.

Captain MOLONY: I have the figures now with respect to the position of the vent in those two guns. In one it was 3·7 inches, in the other it was 6·2 inches.

Major PALLISER: I may mention in reply, that there is a gun on board the "Excellent," that is vented in the same way, 3·7 inches from the end of the bore; and I have received a letter from Captain Hood stating that the gun has been firing 400 rounds, and is still in excellent condition. Then, it has been said that the wrought-iron portion of the gun which burst at Woolwich had not been deteriorated by the hot metal which had been cast round it. All I can tell you is, that many pieces of iron did draw out very well, but that some specimens snapped off short at 13 tons per square inch, showing that the iron had deteriorated.

Captain MOLONY: There were two pieces tested. One yielded at 10 tons to the square inch, broke at 19 tons, and stretched out 0·335. The specimen was only one and a half inch long.

Major PALLISER: Where was it cut from?

Captain MOLONY: It was cut from a piece where it was broken.

Major PALLISER: Whereabouts?

Captain MOLONY: It was a little piece. I cannot tell you exactly where it was cut from. The other piece that was tested yielded at 9·7 tons, broke at 19·4 tons, and stretched 0·51 inch, showing great uniformity with the other piece, which broke at 19 tons, and stretched out 0·335.

Major PALLISER: Do you know what the original strength of that iron was? It is Thorneycroft's best, and the tensile strength goes up to 25 tons to the square inch. According to your own statement, you had breakage at 19 tons. That shows there was a deterioration even in those pieces amounting to 6 tons.

The CHAIRMAN: Has any other gentleman any observation to make, or any question to ask?

Captain HORTON, R.N.: May I be pardoned for asking a question, not for controversy, but for the purpose of obtaining information? It is with reference to the application of the tube form to a gun, a tube bored through. Two or three years ago, in Belgium, I learned from the then Minister of War, a man of science I believe, and certainly informed by a scientific body of artillerists, that they had adopted the theory that the discharge of powder caused vibrations through the length of the tube, which, if the tube were not closed at the breech end, passed off as well there as at the muzzle. I must explain that they use the Krupp-system of stopping a breech-loading gun. The bursting of a gun takes place, I believe, almost universally

at the seat of the powder-charge. Two guns, precisely similar, were adopted for experiment in Belgium—small guns cast in brass. One was left in its normal condition, the other was bored through, and employed in that way as a breech-loader; and the two were experimented upon in order to obtain this information. The gun in its normal condition burst at the 29th round, while the other went on so continuously that the authorities did not care to carry on the experiment any longer; it was assumed that a gun treated in that way was very much stronger than the other. They were induced to continue their practice up to the 68-pounder gun. They were under the impression that the system of loading at the breech was very much more important with larger descriptions of ordnance than with smaller ones; in short, it was their determination to go on from the point at which we appear to have left off in the attempt to load at the breech. I ask this question of Major Palliser, if he will be kind enough to answer from his experience, whether he is of opinion that that system would be applicable to other descriptions of ordnance, either built upon this or any other method, as well as the class of guns I have spoken of, cast in brass. I ask this because it appears to me of great importance, in the present day, when we have ships carrying 9 inches of iron,—it appears to me to be the duty of ships to engage forts from a short distance, to batter them in breach. In short, I believe we shall come to that. There is no reason to the contrary. Let a ship be made as nearly invulnerable as she is in the present day, provided with turrets and proper ordnance, it will be her duty to engage forts instead of trying to slip past them. How are we to do that? I look upon the Americans as practical and very well informed in matters of gunnery. They adhere very steadfastly to the system of spherical shot. I believe they are right. The spherical shot would be the missile to employ, delivered at short ranges and high velocity, for the purpose of breaking down iron shields, or destroying the embrasures of forts; and that system would be best applicable in combination with breech-loading. Therefore the question appears to me to be one of very great importance, not to makers of guns only, but also to both Services. I, therefore, wish to raise the question here.

Mr. MALLET, C.E., F.R.S.: I beg to make one or two remarks. Perhaps I may commence by stating what probably would be a sufficient answer to the question just put; namely, as to whether open breech-tubes are not stronger than closed breech-tubes. Herr Scheffler, a German mathematician, in several papers has rigidly investigated all questions that relate to the expansion of ringed or hooped tubes analogous to those of cannon, and has conclusively proved the enormous superiority in resistance of the closed tube to the breech-loading or open-ended tube. His memoir has been translated by myself, and will be found in the *Practical Mechanics' Journal*. With respect to the paper which we have just heard, I would venture to make one or two remarks. I shall not attempt to go into the general subject, because it is one that involves almost every debated question in respect to the construction of guns, and this is not the proper audience to discuss that. I must regret, as a civil engineer, that Major Palliser does not come to the Institution of Civil Engineers in Great George Street, and fairly put himself into the arena, where he would have to ventilate his ideas and compare them with those of others competent to discuss their merits or demerits. Here he has it pretty nearly all his own way, because there are very few gentlemen in this Institution capable of dealing with questions such as these. I myself at this moment I believe stand alone here as a civil engineer. Now, with respect to what I have heard about the superiority of wrought-iron 10-lb. coiled tubes, as compared with steel tubes, every one who has read what I have written on the subject of iron ordnance, knows that I have been an advocate for wrought-iron coiled tubes; I was one of the first to prove that wrought-iron coiled tubes must be better than the common lap-welded or "skelp"-welded as they are called, or solid bored out tubes, in the proportion of 7 to 1. The argument which I have heard to-night that steel tubes are better than those of wrought-iron, seeming to rest wholly upon the view that the latter are degraded to a greater extent by the blast of powder passing than the wrought-iron tube is.

Captain MOLONY: It is not so in every case.

Major PALLISER: When wads are not employed.

Mr. MALLET: I can only say that in all cases that have come before my eyes, degradation has been somewhat greater with steel than with wrought-iron. And I

may mention that I have had the opportunity of examining the matter closely, because about a year ago or more, I, in concert with Dr. Percy, was called upon to examine the tubes of 9-inch guns that were seriously degraded; some of wrought-iron, coiled, and some of steel. We found the steel was rather more degraded than the wrought-iron; but the difference was so slight, that to base an argument upon that in favour of wrought-iron is perfectly absurd. Let me just remark this. If these steel tubes are so bad, and the wrought-iron ones are so good, is not that a logical cutting away of the basis from under Major Palliser's method of construction altogether? Major Palliser's method, to speak to untechnical apprehensions, is this: that he puts an india-rubber ring outside a glass tube in order to strengthen that tube. That is to say, he puts a wrought-iron tube outside a cast-iron outside. Now, the wrought-iron tube is more extensible than steel, but it is also less extensible than the cast-iron tube outside.

Major PALLISER: No.

Mr. MALLET: I assert as a fact that within the limits of a strain of four or five tons to the square inch, which is all you can get out of the best cast-iron that can be made, the extension per ton per square inch considerably exceeds that of wrought-iron. If that be so, I say Major Palliser's construction is altogether based upon a fallacy. You see the fallacy brought to its *reductio ad absurdum* in that gun, (pointing to the diagram of the burst Palliser gun), which seems to me to be a complete condemnation of the whole system of cast-iron put on over wrought-iron. I may remark that all this business that makes so much noise seems to me to lack novelty altogether. It is at least 150 years old. The celebrated Reaumur, in an original paper which he presented to the Royal Academy of Sciences, suggested—M. Villons and other makers having failed to make wrought-iron guns on much the same system which Treadwell in America has brought up again—Reaumur suggested the idea of making a wrought-iron tube, making it by coil, and putting it inside a cast-iron gun. The Marquis de Courtivron and M. de Bouchu both French iron-masters, between 1755 and 1780, both re-produced the same idea. Monge, the celebrated author of the "Géométrie Descriptif," reproduced the same idea in 1813, after the disasters of the Russian campaign, when the French artillery was gone, and the question was how it was to be restored in a few months. There is nothing new in the idea of putting a wrought-iron tube inside a cast-iron gun. I fail to see the merit of the scheme in point of novelty, and I fail to see the merit of it in a practical point of view. I must say, having myself no holy reverence for the recommendation of an Ordnance Select Committee, nor yet any disrespect for them, that the mere fact that they have recommended guns to be converted in this way, fails to convince me that it will not be a positive national disaster if any considerable number of our guns be converted on any such a system. In support of that, I can do no more here than venture a bold assertion; I say upon that system you will never have a safe gun. I say further, that you will never make any gun that exists in the British service, when so converted, a useful gun. There is not one of the great military powers of Europe at the present moment that has not seen the fact, that whenever the tug of war comes, the smooth-bore will come into action again. The Prussians have not even abandoned their smooth-bore field batteries. I say no smooth-bore gun in the British service ought to be destroyed except below the calibre of an 18-pounder. Then, as regards the 32-pounders and the larger guns, keep them smooth-bores as they are, and you will find a real use hereafter for them. Attempt to convert them upon this plan, and you will simply destroy them as smooth-bores, and you will make them perfectly useless for any purpose, because too small; and utterly untrustworthy as rifles.

The CHAIRMAN: Do you wish to reply, Major Palliser?

Major PALLISER: I must say before replying, that I think it is scarcely fair to a man, not much given to public speaking, to have to jump up and reply at score to a carefully prepared attack by a well-known man like Mr. Mallet. I rather deprecate it, that in the discussions in this place, one is rather put up as a target for every one to have a shot at.

Mr. MALLET: Allow me to assure you that until I came into this room I had not the slightest idea of saying one word. It was not until four o'clock to-day that I knew you were going to deliver this lecture, and not one word that I have said was prepared.

Major PALLISER: After that statement will you answer one question? There has been such a remarkable similarity between your remarks and remarks that have appeared in newspapers, that I ask you, are you the author of the article that described me as "a man with a maggot in his head?"

Mr. MALLET: I am not the author of any article that called you "a man with a maggot in his head."

Major PALLISER: Or "a maggot in his brain?"

Mr. MALLET: I never used such an expression with respect to you, and, as a gentleman, I should never use such an expression as to any one. That is my negative answer. My positive reply is, I am the author of several articles in the *Engineer*, on Artillery, and, among others, of one upon the subject of your guns.

Major PALLISER: That is the article I allude to. It describes me as "a man with a maggot in his head." * At all events, your having acknowledged that you are the author of an article in the *Engineer* writing down my gun, shows that you are not unprepared to take part in this discussion, because you have repeated to-night many of the observations that appeared in that article, verbatim. For instance, the expression about putting wrought-iron inside cast-iron being like putting glass inside india-rubber. If you look at the patent I took out in 1862, you will see that I distinctly distinguish between the qualities of elasticity and extensibility. There is no term which I have seen more confounded than the term "elasticity." "Elasticity" is very often used in common parlance as the quality which represents the amount a thing can stretch. It is not. Elasticity is that power which a substance has to revert back to its original shape. Extensibility, on the other hand, is the quality which a tough body has of being drawn out without any reference to returning to its original form. I said that wrought-iron by its extensibility was able to excite and call to its assistance the strength of the surrounding portions of the metal. This has been conclusively proved by experiments, and here is the gun that I have tried it upon. I fully admit, on the other side, that if you expose a wrought-iron tube to the continuous test of excessive firing, you will eventually split the tube. But as long as that tube is new and not worn out, I defy you to burst the tube inside the casing of cast-iron with any charge that a wrought-iron gun will resist. I wish to say one thing more, which I forgot at the time. It is stated that my gun is vented at the end near the breech. I beg to state that my gun at Shoeburyness is not vented at the end; it is vented 4½ inches from the end. In addition to that, I was not satisfied with the 8-inch rifle-converted gun firing 30 lbs. powder and 180 lbs. shot by means of a rear vent, but I pierced the gun with a second vent, 8½ inches, from the end of the bore; I fired ten rounds with 30 lbs. powder as before, and 180 lbs. shot, and when I took the expansions of the gun, they amounted to nothing. With regard to extensibility, Mr. Mallet seems to think that Military men are not capable of expressing an opinion upon the properties of iron; that a man must be a Civil Engineer to be able to do so. I beg to say that I have gone through a course of study on these subjects quite equal to that of any Civil Engineer. Now, I wish to point out, that if you take a piece of soft iron which breaks at 22 tons to the square inch, and if you take the strength per fractured area of that iron, you will find it is nearly as strong as the strength per fractured area of steel. Therefore, I say that a cast-iron gun lined with a wrought-iron coiled barrel will bear an enormous amount of strain before it gives way; and further, the expansions are so very small in the gun, that the limits of extensibility of wrought-iron are never approached. The best proof I can give is that my 9-inch gun only expanded $\frac{1}{100}$ths of an inch; that that expansion took place in the first few rounds; and that the subsequent 500 rounds expanded it but very little, and that the barrel of a lined gun

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* Mr. Mallet claims permission to place here on record, that in nothing that he has ever written has he ever used the discourteous expression here again attributed to him by Major Palliser—after his denial of it. Mr. Mallet knows nothing of expressions that may or may not have been employed by other writers in the *Engineer* on artillery. He denies having any prejudice, or having ever attempted to "write down Major Palliser's gun" in any way but by stating fairly the objections to it, as apparent to him.—18th November, 1868, R. M.

expanded more than half an inch without bursting, when the casing gave way. With regard to what constitutes an original invention, I would state that it is not the man who merely suggests that a thing may be done, but the man who patiently works at it until he shows how it can be done, who is the inventor. I might suggest that you might propel a railway train by galvanism, but if I did nothing more than that, I could not claim to be the inventor of a galvanic locomotive engine. With regard to the recommendations of the Ordnance Select Committee, which Mr. Mallet does not seem to value, I have to say, give me as judges practical men, gentlemen, unprejudiced men, who will be guided in their decisions by the practical results of experiments; and not men who have preconceived opinions, no matter what their professional education may be. Something was said about smooth-bore guns. I would merely remark that the new calibre of the converted 64-pounder is exactly the same that it was before, so that if you wish to fire a round shot out of that gun you can do so, and put in much more powder than before. The great mistake that I made with regard to chilled shot was in the name which I gave them. Had I given them a good distinctive name, my originality would never have been questioned. If I had called them "refined iron shot," nobody would have objected to the term; but, unfortunately, because I produced refined iron shot in the chilled shape, and because none had been previously chilled in the mould, an objection was made. Mr. Gruson, of Magdeburg, is very much written up in the *Engineer*. I admit that his shot were chilled; his shot *were* partially chilled shot with bluff-heads, while mine are, and always were chilled pointed shot. Last week an English gun was taken to Berlin, and was tried against a Prussian gun. The English gun was fired with 43 lb. charges and 250 lbs. projectile; the Prussian gun was fired with 45 lbs. powder, and the weight of its projectile was 320 lbs. I was informed that the English, *i.e.*, my shells went completely through the target at 500 yards, and that the Prussian shells stuck in the target.

The CHAIRMAN: I do not know whether any other gentleman wishes to address the meeting. If not, I will make a few observations as Chairman.

Mr. MALLET: Am I precluded from making one or two remarks with regard to elasticity or extensibility?

The CHAIRMAN: Is it applicable to the subject before us?

Mr. MALLET: It is directly applicable. Anything that I have said as regards the relations between wrought iron internal tubes and cast iron external ones, will apply equally well, whether you use the terms elasticity or extensibility. All that elasticity means, as regards such questions as we have before us, namely lineal elasticity, is simply how much a thing that is pulled out shall go back again. Within certain limits everything that is pulled out will go back. Those are called the limits of its elasticity. If a thing is pulled out beyond those limits, it ceases in so far to be elastic, it will not go back again. Therefore, you may as well call it elasticity as extensibility, because the difference, if any, depends simply upon the degree to which the thing is pulled out.

Major PALLISER: May I make one remark? I interrupt you for one moment. You instanced glass as representing my coiled barrel. Now, it so happens that glass is the most elastic substance that we have. If you drop down a glass ball 15 feet, I believe it will bound up 13 feet; therefore its co-efficient of elasticity may be represented as 13 divided by 15—perfect elasticity being represented by unity.

The CHAIRMAN: Captain Horton has not received a reply from you about open tubes.

Captain HORTON: My question is, whether a gun is stronger for being an open tube at the rear, so that it can be employed as a breech-loader to propel round shot at high velocities, than being closed at the end and used as a muzzle-loading gun? I am speaking of guns of large size, and I ask whether you think the system of breech-loading is not applicable to guns on a large scale, rather than to those of smaller dimensions?

Major PALLISER: I quite agree with you that the great desideratum is to obtain a good breech-loader. And I also agree with Mr. Mallet, that in the Prussian system of breech-loading, that form of strain acts no further than where you cut the barrel off. There is not the help and assistance to the arch that there is here; therefore, a tube cut off flush, like the Prussian tube is, must be weaker. On the

other hand the French have obtained very astonishing results with their breech-loaders. However, they eventually become muzzle-loaders. The breech screws right up into the bore; so that I think the French are working in the right direction for a breech-loader. But until we can get a breech-loader that is so absolutely reliable, that in the heat and hurry of action a man cannot put it out of order, I think it is far safer to retain the present muzzle-loader.

The CHAIRMAN: I must say that, viewing as I do, apart from all personal or interested considerations, the papers which Major Palliser has read in this Institution, they appear to me to have this practical value, that they set forth to us in clear, intelligible, and in fair language the progress of his inventions, their processes and their failures, as well as their successes. I think we owe to him our thanks for what he has favoured us with this evening, as much for the description of those guns formed with wrought-iron cores and cast-iron bodies over them, as for the description of those remarkably successful guns which are manufactured by the insertion of a wrought-iron tube into a cast-iron gun already in existence. The experiments which have produced these results, are as valuable in regard to failures, for they point out to us errors that ought to be avoided, as they are in reference to their successes. I do hope that, as the Government acknowledged Major Palliser's eminent services in the invention, if I may so use the term, or rather in the development of the invention of the refined white iron shot, so he will not be allowed to be a loser by those valuable results, which have proved that cast-iron over a wrought-iron core is not a construction that can be safely used. With regard to the second method by which wrought-iron tubes are introduced into cast-iron guns already formed, I speak from memory, but I think in a paper read here last year, Dr. Twisden showed, that a construction of that kind gives a gun double the strength which it had before; whereas wrought-iron coiled over a cast-iron gun does not increase the strength of the gun perceptibly; that is, the difference is small in the ratio of 176 to 170. As regards the two principles of ordnance, that which we adopt secures penetration and long range, compared with the American system, which is that of smashing at short distances. It was told us a few evenings ago in this theatre by a gentleman, whose paper was received with the greatest applause, Captain Hamilton, that our Cousins across the water, who certainly are individually as clear-headed as most men, and nationally as clear and far-seeing as most nations, were giving up their heavy, large-diameter spherical shot, their Rodmans, Columbiads, and Parrott guns, and that they were introducing a compound gun, such as we are now making. I think we may be proud of our countryman, Major Palliser, and that the Institution owes him a great deal for having made this Theatre the arena for expounding his principles. His name will be for ever associated in history as one of the great pioneers in the improvement of artillery. Speaking myself as an unprejudiced man, the experiments which he has described with the guns, constructed with wrought-iron cores let into cast-iron bodies, have to my mind carried conviction with them; and I have no doubt, that as his great experimental knowledge and practice enable him to go on, we shall not suffer in the end from not having trustworthy guns for secondary purposes of defence. I believe we have already got trustworthy guns, and that we shall probably have those which are more so. In experiments in the mechanical arts, it is not possible for any nation to retain exclusively that which they invent. The progress of science has made such great advances, intercommunication of ideas, is so easy, and the means of communication especially by the Telegraph are so expeditious, that what one nation invents, another nation can easily and at once appropriate. Therefore, we cannot expect to hold our own inventions exclusively either with regard to guns, or with regard to shot. Other nations will adopt them. But there is one thing they cannot do; they cannot deprive Major Palliser of the credit of his inventions, which have been advanced step by step on the basis of a practical experience gained as he has gone on. Neither can any other nation, as in the case of Captain Cook, claim a joint nationality in Major Palliser. We claim him as our own, as we also claim the merit of his inventions also. I am sure I only express the feelings of this meeting, when we offer him our warmest thanks for the pains he has taken in explaining to us this evening the principles on which he has carried on his experiments.

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LECTURE.

Friday, June 5th, 1868.

GENERAL SIR WILLIAM J. CODRINGTON, G.C.B., in the Chair.

PRIMITIVE WARFARE, SECTION II. ON THE RESEMBLANCE OF THE WEAPONS OF EARLY RACES; THEIR VARIATIONS, CONTINUITY, AND DEVELOPMENT OF FORM.

By Colonel A. H. LANE FOX, late Grenadier Guards.

General Remarks.

IN June 1867, I had the honour of reading a paper at this Institution, which has since been published in its Journal, the object of which was to point out the resemblance which exists between the weapons of savages and early races and the weapons with which nature has furnished animals for their defence.

In continuation of the same subject, my present communication will relate to the resemblance to each other of the weapons of races sometimes widely separated, and of which the connection, if it ever existed, has long since been consigned to obscurity. I shall endeavour to show, how in these several localities, which are so remote from one another, the progress of form has been developed upon a similar plan and, though to all appearance independently, yet that under like conditions like results have been produced, and that the weapons and implements of these races will sometimes be found to bear so close a resemblance to each other, as often to suggest a community of origin where no such common origin can have existed, unless at the very remotest period.

We shall thus be brought to the consideration of the great problem of our day, viz., the origin of mankind, or rather the origin of the human arts; for the question of man's origin, whether he was himself created or developed from some prior form, whether since the period of his first appearance he has by variation separated into distinct races, or whether the several races of mankind were separately created, are

questions which, however closely allied, do not of necessity form part of our present subject. It has to deal solely with the origin of the arts and more particularly with the art of war, which in the infancy of society belonged to a condition of life so constant and universal as to embrace within its sphere all other arts, or at least to be so intimately connected with them as to require the same treatment, the tool and the weapon being, as I shall presently show, often identical in the hands of the primeval savage.

These prefatory remarks are necessary because it will be seen that the general observations I am about to offer on the subject are fully as applicable to the whole range of the industrial arts of mankind as to the art of war. My illustrations, however, will be taken exclusively from weapons of war.

Is not the world at the present time and has it not always been the scene of a continuous progress? Have not the arts grown up from an obscure origin, and is not this growth continuing to the present day?

This is the question which lies at the very threshold of our subject, and we must endeavour to treat it by the light of evidence alone, apart from all considerations of a traditional or poetic character.

I do not propose here to enter into a disquisition upon the functions of the human mind. But it must I think be admitted, that if man possessed from the first the same nature that belongs to him at the present time, he must at the commencement of his career in this world have been destitute of all creative power. The mind has never been endowed with any creative faculty. The only powers we possess are those of digesting, adapting, and applying by the intellectual faculties, the experience acquired through the medium of the senses. We come into the world helpless and speechless, possessing only in common with the brutes, such instincts as are necessary for the bare sustenance of life under the most facile conditions; all that follows afterwards is dependent purely on experience.

Whether we afterwards become barbarous or civilized, whether we follow a hunting, nomadic, or agricultural life, whether we embrace this religion or that, or attain proficiency in any of the arts, all this is dependent purely on the accident of our birth which places us in a position to build upon the experience of our ancestors, adding to it the experience acquired by ourselves. For although it is doubtless true that the breeds of mankind, like the breeds of our domestic animals, by continued cultivation during many generations have improved, and that by this means races have been produced capable of being educated to a higher degree than those which have remained uncivilized, this does not alter the fact that it is by experience alone, conscious or unconscious, self imposed or compulsory, and by a process of slow and laborious induction, that we arrive at the degree of perfection to which according to our opportunities and our relative endowments, we ultimately attain.

The amount, therefore, which any one individual or any one generation is capable of adding to the civilization of their age must be immeasurably small, in comparison with what they derive from it.

I could not perhaps appeal to an audience more capable of appreciating the truth of these remarks than to the members of an Institution, the object of which is to examine into the improvements and so-called inventions which are from time to time effected in the machinery and implements of war.

How often does any proposal or improvement come before this Institution which, after investigating its antecedents, is found to possess originality of design? Is it not a fact that even the most ingenious and successful inventions turn out on enquiry to be mere adaptations of contrivances already existing, or that they are produced by applying to one branch of industry the principles or the contrivances which have been evolved in another? I think that no one can have constantly attended the lectures of this or any similar Institution, without becoming impressed, above all things, with the want of originality observable amongst men, and with the great calls which, even in this age of cultivated intellects and abundant materials to work upon, all inventors are obliged to make upon those who have preceded them.

Since then we ourselves are so entirely creatures of education, and derive so little from our own unaided resources, it follows that the first created man, if similarly constituted, having no antecedents from which to derive instruction, could not, without external aid, have made any material or rapid advance towards the initiation of the arts.

So fully has the truth of this been recognised by those who are not themselves advocates for the theory of development, that in order to account for the very first stages of human progress they have found it necessary to assume the hypothesis of supernatural agency; such we know was the belief of the classical pagan nations, who attributed the origin of many of the arts to their gods; such we know to be the tradition of many savage and semi-civilized nations of modern times that have attained to the first stages of culture. But we have already disposed of this hypothesis at the commencement of these remarks, by deciding that our arguments should be based solely upon evidence. We are, therefore, under the necessity of assuming, in the absence of any evidence to the contrary, that none but the agencies which help us now were at the disposal of our first ancestors, and the alternative to which we must have recourse is that of supposing that the progress of those days was immeasurably slower than it is at present, and that vast ages must have elapsed after the first appearance of man before he began to show even the first indications of a settled advance.

Yet the complex civilization of our own time has been built on the foundations that were laid by these aborigines of our species, while the brute creation may be said to have produced little more than was necessary to their own wants or those of their immediate offspring. Man has been the agent employed in a work of continuous progression. Generation has succeeded generation, and race has succeeded race, each contributing its quota to the fabrication of the edifice and then giving place to other workmen. But the progress of the edifice

itself has never ceased, it has gone on, I maintain, contrary to the opinion of some writers of our day; always in fulfilment of one vast design. It is a work of all time.

To study it comprehensively, we must devote ourselves to the contemplation of the edifice itself, and set aside the study of mankind for separate treatment, for it is evident that man has been fashioned, not as the designer, but simply as the unconscious instrument of its erection. Each individual has been impelled by what,—viewed in this light,—may be regarded as instincts sufficient to stimulate him to labour, but falling immeasurably short of a comprehensive knowledge of the great scheme, towards which he is an unconscious contributor. Of this he knows no more than the earthworm knows it to be its function to cover the crust of the earth with mould, or the small coral polypus knows that it is engaged in the erection of a barrier reef. No comprehensive scheme of progress need be searched for in the pigmy intellect of man, and if we are ever destined to acquire any knowledge of the laws which influence the growth of civilization, we must look for them in an investigation of the phenomenon itself, by studying its phases and the sequence of its mutations. In short we must apply to the whole range of human culture, to the arts, whether of peace or war, the same method which has already been applied with some success to the history of language.

It has been shown that the speech of our own day has been the work of many generations and of innumerable distinct races; its roots are traceable in the utterances of the untutored savage. No nation ever consciously invented a grammar, and yet language has been shown to be capable of being treated as a science of natural growth, having its laws of mutation and development, never dreamt of by any of the many myriads of individuals that have unconsciously contributed to the formation of it. May not all the products of human intellects in the aggregate be made amenable to the same treatment, and like language be found to be influenced by laws of evolution and progress?

That these remarks are not merely speculative, that the progress of civilization has been continuous and connected, while the races which have been engaged in the formation of it, like individuals, have had their periods of birth, maturity, and decay, is sufficiently proved by history.

In Egypt and in Assyria, we see the remains of ancient and formerly populous cities, where now the nomadic Arab pitches his tent or wanders with his flocks, thus showing that relapses of civilization must have occurred in those particular localities where such phenomena are observed. But we know also from history that the civilization which once flourished in those countries did not expire there, but was transferred thence to other places; that the culture of Assyria and of Egypt passed into Greece and developed there; that from Greece it extended to Rome, and in the hands of a new people passed through fresh phases; that after the destruction of the Roman empire it lay dormant for many ages, only to rise again on its original basis extended and fertilized by the introduction of fresh blood; that we ourselves

are the inheritors of the same arts, customs, and institutions, modified and improved; and finally that civilization expanding in all directions, as it continues to move westward, is now in process of being received back by those ancient countries in which it originated, in a condition far more varied and diversified than it could ever have become, had it been confined to a single people or country.

Passing now from the known to the unknown, we come to the study of pre-historic times prepared to find that every fresh discovery helps us to trace backwards the arts of mankind in unbroken continuity towards their source.

Commencing with the Saxon and the Celt, and passing from these to the lake dwellers, and on to the inhabitants of caves, races whose successive periods of existence are determined chiefly by the animals, with which their remains are associated, we find that according to their antiquity, they appear to have lived in a lower and lower condition of culture, until in the drift period, coeval with the extinct mammoth and the woolly haired rhinoceros, we find the earliest traces of man, scanty and unsatisfactory though they be, yet sufficient to show that he must have existed in a state so rude, as to have devised no better implements than flints pointed at one end, and held in the hand.

These successive pre-historic stages of civilization have been divided into the stone, the bronze, and the iron ages of mankind. The evidence upon which this classification is based, has been so ably set forth in the works of Sir John Lubbock and others, that I need not refer to it further than to state that, in my treatment of the origin and development of the weapons of war, I shall in a great measure follow the same arrangement. But I shall endeavour to trace the development of *form* rather than the *material* of weapons, and to show by examples taken from various distinct periods, and especially by illustrations taken from existing savages, the various agencies which appear to have operated in causing progression during the earliest ages of mankind.

Of these, the first to be considered, is undoubtedly the utilization and imitation of natural forms. Nature was the only instructor of primeval man.

In my previous paper, I discussed this subject at some length, giving many examples in which the weapons of animals have been employed by man. But besides these weapons derived from animals, primeval man must no doubt at first have employed the natural forms of wood and bone, and of stones either fractured by the frost, or rolled into convenient forms upon the sea-shore.

This principle of the utilization and imitation of natural forms appears to bear precisely the same relationship to the development of the arts, that in the science of language, onomatopœia has been shown to bear to the growth and development of articulate speech. In the attempt to trace language to its origin, onomatopœia, or the imitation of the sounds of animals and of nature, appears not only to have been the chief agent in *initiating* the growth of language, but it has also served to enrich it from time to time, so that even to this day, poetry

and eloquence in a great measure depend on the employment of it. But apart from this, language has had an independent and systematic growth of its own.

So in like manner, men not only drew upon nature for their ideas in the infancy of the arts, but we continue to copy the forms and contrivances of nature with advantage to this day. But apart from this, we must look for an independent origin and growth, in which form succeeded form in regular continuity. Many a lesson has still to be learnt from the book of nature, the pages of which are sealed to us until by the natural growth of knowledge, we acquire the power of reading and applying them. Imitation therefore, though an important element in the initiation of the arts, would not alone be sufficient to account for the phenomenon of progress.

The next principle which we shall have to consider, is that of variation. Amongst all the products of the most primitive races of man, we find endless variations in the forms of their implements, all of the most trivial character. A Sheffield manufacturer informed me, that he had lately received a wooden model of a dagger-blade from Mogadore, made by an Arab, who desired to have one of steel made exactly like it. Accordingly, my informant thinking that he had found a convenient market for the sale of such weapons, constructed some hundreds of blades of exactly the same pattern. On arriving at their destination, however, they were found to be unsaleable. Although precisely of the type in general use about Mogadore, and all of which to the European eye would be considered alike, their uniformity rendered them unsuited to the requirements of the inhabitants, each of whom piqued himself upon possessing his own particular pattern, the peculiarity of which consisted in having some almost imperceptible difference in the curve or breadth of the blade.

In the earliest stages of art, men would of necessity be led to the adoption of such varieties by the constantly differing forms of the materials in which they worked. The uncertain fractures of flint, the various curves of the trees out of which they constructed their clubs, and the different forms of bones, would lead them imperceptibly towards the adoption of fresh tools. Occasionally some form would be hit upon, which in the hands of its employer, would be found more convenient for use, and which by giving the possessor of it some advantage over his neighbours, would commend itself to general adoption. Thus by a process, resembling what Mr. Darwin, in his late work, has termed "unconscious selection," rather than by premeditation or design, men would be led on to improvement. By degrees some forms would be found best adapted to one pursuit, and some to another; one would be used for grubbing up roots, another for breaking shells, another for breaking heads; modes of procedure accidentally hit upon in one class of occupation, would suggest improvements in another, and thus analogy, coming to the aid of accidental variation, would give an impulse to progress. Thus would commence that ramification of the arts, occupations, and sciences which developing simultaneously and assisting each other, has born fruit in the civilization of our own times.

I am aware that it will be found extremely difficult to realize a con-

dition of human existence so low as that which I am supposing, and that many persons will deny the possibility of mankind having ever existed in a condition so helpless as to have been incapable of designing the simple weapons which we find in the hands of savages at the present day. It is as difficult to place one's self in the position of a being infinitely one's inferior, as of a being greatly one's superior in intellect. "Few persons," says Professor Max Müller, "understand children, still fewer antiquity." Our own experience cannot save us in estimating the powers of either, for long before the period of which we have the earliest recollection, we had ourselves undergone a course of unconscious education in the arts of a civilized community; our very first utterances were in a language which was in itself the complex growth of ages, and the improvement of our natural faculties resulting from the continued cultivation of our race, enhances the difficulty we find in appreciating the condition of our first parents.

Another fertile source of variation arises from errors in successive copies. At a time when men had no measures or other appliances to assist them in copying correctly, and were guided only by the eye, an implement would soon be made to assume a very different appearance. Mr. Evans has shown in his work on "Ancient British Coins" how the head of Medusa, copied originally from a Greek coin, was made to pass through a series of apparently meaningless hieroglyphics, in which the original head was quite lost, and was ultimately converted into a chariot and four. We must not, however, attribute all variation to this cause, for I quite agree with a remark made by Mr. Rawlinson in his "Five Ancient Monarchies," that such varieties are more frequently noticed in cases where the contrivance is of home growth, than in those which are derived from strangers.

The third point which we shall have to consider in relation to continuity, is the retarding element. Under this head, incapacity must at all times, and especially in the infancy of society, have played the chief part. But as civilization progressed, other agencies would come in to influence the same result, prejudice, force of habit, principles of conservatism in which we have been told by Mr. Mill that all the dull intellects of the world habitually ensconce themselves, a thousand interests of a retarding tendency, rise up at the same time as those having a progressive influence, and prevent our advancing by other than well-measured paces.

The resultant of these contending forces is continuity. If we could but put together the missing links; if we could revive contrivances that have died at their birth, and expose piracies; if we could penetrate the haze that is so often thrown over continuity by great names, absorbing to themselves the credit of contrivances that belong to others, and thereby causing it to appear that progress has advanced with great strides, where creeping was in reality the order of the day; we should find that there is not a single work of man's hand which has not its history of slow and continuous development, capable of being traced back, like branches of a tree, to its junction with others, and so on until the roots of all are found to lie in the simplest contrivances of primeval man.

But we must not expect that we shall be able, in the existing state of knowledge, to trace this continuity from first to last, for the links that are lost, far exceed in number those which remain. The task may be compared to that of putting together the fragments of a tree that has been cut up for firewood, and of which the greater part has been burnt. It is only here and there, after diligent search, that we may expect to find a few pieces fitting in such a manner as to prove that they belonged to the same branch. We do not, on that account, abandon our conviction that the tree once grew, that every large branch was once a small twig, and that every limb developed by a natural process into the form in which we find it. The difficulty we have to contend with, is precisely that which the geologist experiences in tracing his palæontological sequence. But it is far greater, for natural history has been long studied, and the materials upon which Mr. Darwin founds his celebrated hypothesis have been in process of collection for many generations. But continuity, in relation to the arts, can scarcely yet be said to be established as a science. The materials for the science have not yet been even classified, and classification is a process which must always precede continuity in the study of nature. Classification defines the margin of our ignorance; continuity results from the extension of knowledge by bridging over the distinction of classes. Travellers, for the most part, have been in the habit of bringing home, as curiosities, the most remarkable specimens of weapons and implements, without much regard to their history or the evidence they convey, and their descriptions of them, as a general rule, have been extremely meagre. Until quite recently, the curators of our ethnographical museums have aimed more at the collection of unique specimens, serving to exhibit well-marked differences of form, than such as by their resemblance enable us to trace out community of origin. The arrangement of them has been almost universally bad, and has been calculated rather to display the several articles to advantage, on the principle of shop windows, than to facilitate the deductions of science. The antiquities of savage races, moreover, have as yet been almost wholly unstudied.

Notwithstanding these difficulties, we are able to catch glimpses of evidence, here and there, which when put together systematically, and when the vestiges of antiquity are illustrated by the implements of existing savages, will, I trust, be found sufficient to warrant the principles for which I contend.

Combination of Tool and Weapon.

In the earliest ages of mankind, when all men were warriors, and before the division of labour, consequent on civilization, had separated the arts of peace and war into distinct professions, we must expect to find the same implement frequently employed in the capacity of both tool and weapon. Even long after the very earliest ages of which we have any historical or archæological record, we often find a combination of tool and weapon in the same forms, especially amongst those semi-civilized and savage races of our own times, whom we regard as

the representatives of antiquity. The battles of liberty, from the age of the Jews and Philistines down to the time of the last Hungarian revolution, have always been fought by the subject people with weapons made out of the implements of husbandry. We read in the first of Samuel, chapter xiii, "Now there was no smith found in all the "land of Israel, for the Philistines said, lest the Hebrews make them "swords or spears; but all the Israelites went down to the Philistines "to sharpen every man his share" (the blade of the ploughshare), "and his coulter" (a kind of knife), "and his axe, and his mattock" (a kind of pickaxe). . . . . "So it came to pass, in the day of "battle, that there was neither sword nor spear found in the hand of "any of the people that were with Saul and Jonathan." In the revolts of the German peasantry, in the fifteenth and sixteenth centuries, the bands of insurgents armed themselves with threshing flails and scythe blades. In 1794 and 1831, the Polish peasantry were similarly armed;* and it was from such implements of husbandry that weapons like the military flail, the bill, and the yatagan, derived their origin. In the recent outbreak in Jamaica, which, had it not been ably and powerfully put down, would have led to the destruction of the whole white population, the negroes armed themselves with weapons of husbandry. In the proclamation of Paul Bogle, he says: "Every "one of you must leave your house, take your guns; who don't have "guns, take cutlasses." The cutlasses here referred to, were the implements used for cutting the sugar cane, sharp on the concave edge, and are the same which, having been used as weapons by the negroes in their own country, have continued to be employed by them ever since. In like manner, we learn from Symmes's embassy to Ava, in 1795,† that the Burmese use the sabre both for warlike purposes, as well as for cutting bamboos, felling timber, &c.; it is the constant companion of the inhabitants for all purposes, and they never travel without it. In Borneo, the peculiar sword-like weapon, called the parangilang, is used both as a weapon, and also for felling trees, and the axe of this country is constructed so that, by turning it on the helve, it can be used either as a weapon or as a carpenter's axe. In like manner, the Caffre axe-blade, by simply altering its position in the handle, is used either as a weapon, or for tilling the ground. The North American Indian tomahawk, like the Caffre axe, is used for many different purposes; the spear head of the Caffre assegai is the knife that is used for all purposes of manufacture, and Captain Grant says that the Watusi of East Central Africa make all their baskets with their spear heads.‡ The weapons edged with sharks' teeth, to which I referred in my former paper, are used in the Marquesas and other of the South Sea Islands, as much for cutting up fish and carcasses as for warlike purposes.§ Dr. Klemm, in his valuable work on savage and early weapons, describes the wooden pick used by the inhabitants of New Caledonia both as a weapon, and also for tilling the ground, and he gives reasons for supposing that in Egypt and many other parts of the world, the form

* Klemm.
† Pinkerton vol. ix, p. 500.
‡ Walk across Africa, p. 78.
§ Klemm.

of the plough was originally derived from that of the hatchet or hoe, used for tilling purposes. The hoe used in East Central Africa, which also, like the Caffre axe, serves as a medium of exchange in lieu of money, evidently derived its form from that of a spear or arrow head. The spade formerly used in this country, and represented in old pictures, and which is still used as a shovel in Ireland, is a pointed spear-like instrument, and the loy or spade still used in all parts of Ireland is hafted exactly in the same manner as the bronze celt of pre-historic times. Dr. Klemm gives an illustration of an axe used by the Norwegian peasants both as a tool and weapon. Speke describes the Usoga tribe as being armed with huge short handed spears, adapted rather for digging than for war; and Barth describes the Bornonese troops in Central Africa digging holes with their spears, and employing them in searching for water. The Australian "dowak," a kind of club with a flint attached, combines the purposes of a tool and weapon. We know from the short sticks upon which the small arrow heads of quartz found in the Peruvian tombs are mounted, that they must have been used as knives as well as for missile purposes. Professor Nilsson says that flint-barbed arrow heads, of precisely the same form, are used by the inhabitants of Terra del Fuego as knives, and Mr. Stephens, in his travels in Central America, shows reason for supposing that the large stone idols in Copan, were carved with similar arrow points,* no other instrument capable of being used for such a purpose having been found in the neighbourhood.

Examples of this class of evidence might be multiplied *ad infinitum;* but enough has already been said to afford good grounds for believing that many of the implements of stone and bronze which are found in the soil, may have been used for a great variety of purposes, and that, especially in the earliest stages of culture, we must be careful how we attribute especial purposes to tools and weapons because they appear to differ from each other slightly in form. This is more especially so when, as is almost invariably the case, the several distinct types are found—when a sufficient number of them are collected and arranged—to pass almost imperceptibly into each other by connecting links, showing that the differences observable between any two implements of the same class, when brought together and contrasted, are rather due to the operation of a law of variation and development in the fabrication of the tool itself, than to an intention on the part of the constructor to adapt it to particular purposes, and that its application to such especial purposes must have followed, rather than itself have influenced, the development of the tool.

Transition from the Drift to the Celt Type (Plate XVII).

My first illustration must of necessity be taken from the flint implements of the drift, the earliest records of human workmanship that the researches of science have as yet revealed to us. These, to use the words of Sir Charles Lyell, "were probably used as weapons both of

* "Stephens' Travels in Central America," page 94.

"war and the chase, to grub roots, cut down trees, or scoop out "canoes."*

I will not attempt during the brief time allotted to me on the present occasion, any detailed account of the evidence of the antiquity of these weapons, assuming that the works of Sir Charles Lyell, and Sir John Lubbock, will have rendered this subject more or less familiar to most persons at the present day, but I will confine myself to pointing out the indications of variation and of improvement observable in the implements themselves.

I have arranged upon Sheet No. 1 of illustrations (Plate xvii), a series of specimens of the same type from nearly every part of the globe.

All the figures given in these illustrations are traced from the implements themselves, and reduced by photography; they may therefore be regarded as fac similes, a point of great importance when our subject has to deal with the minute gradations of difference observable between them. Figures 1 to 11 are of the drift type. Casts of the originals of some of them, and specimens of the implements themselves, are also upon the table for comparison.

I may here acknowledge the great obligations I am under to Mr. Franks for the facilities he has afforded me in drawing many of these specimens in the Christy Collection, to Dr. Watson for a similar permission in regard to the valuable collection of arms in the India Museum, and also to Dr. Birch of the British Museum. A large proportion of my illustrations are taken from the excellent Museum of this Institution, and others are from my own collection.

Of the drift specimens which I have selected as illustrations, five are from the gravel beds of St. Acheul, in order that we might have an opportunity of observing the variation in implements derived from the same locality, and probably belonging to the same or nearly the same period—chips in fact from the same workshop.

It has been usual to classify these drift implements in two divisions; the spear-head form, and the oval form. Of the first or spear-head form, figures 2 to 4 are typical examples; of the oval form, figure 8 is the best illustration. I venture, however, to think that a distinction more clearly embodying a principle of progress may be made by dividing them differently, and by placing in the first class those which are either left rough or rounded at one end and pointed at the other, of which figures 1 to 7 are examples; and in the second class, such as are chipped to an edge all round, of which figures 8 to 11 are types. My reason for preferring this classification to one dependent on outline is this. The first class having the natural outside coating of the flint or a roughly rounded surface on one side, appears to be in every way adapted to be held in the hand; whereas the second class, of which a beautiful specimen in the Christy Collection from St. Acheul is represented in a front and side view in figure 10, could not conveniently be used in the hand as a tool or weapon, without injury to the hand from the sharp edge with which its periphery is surrounded on all sides. If, therefore, we see reason for supposing that one class of implements

* "Antiquity of Man," p. 113.

was employed in handles, whilst the other may have been used in the hand, I think this constitutes a more important distinction, and one more obviously implying progress, than a classification which merely involves a modification of outline, which may have resulted from no more significant cause than a difference in the form of the flint nodule out of which the implement was made.*

Another important distinction between these drift implements as thus arranged, arises from the different purposes to which they may have been put by the fabricators. The first class, figures 1 to 7—it will be seen by the side view of them—could have been used only as spears, picks, or daggers, the pointed or small end being employed for that purpose, whereas the latter class, figures 8 to 11, are equally available for use as axes with the sharp and broad end. It is quite possible therefore, that we may see here, in these vestiges of the first tools of mankind (specimens of all varieties of which are found in the same beds at Acheul), the point of divergence between the two distinct classes, which must certainly be regarded as the two most constant and universal weapons of mankind in all ages and countries of the world, viz., the spear, and the axe; the small end developed into the spear and into all that class of tools for which a point is required, and from the broad end we obtained the axe and all those tools which either as chisels, choppers, gouges, or battle-axes, have continued in use with an endless continuity of development and modification and a world wide history, up to the present time. I am aware that in the St. Acheul implements, as well as in those of similar form from the laterite beds of Madras, we find occasionally specimens in which the small end is made broader, as if indicating the gradual development of an edge on that side, but upon the whole I think the balance of evidence is in favour of the broad end having originated the axe form.

Nothing, it will be seen, can be more primitive than these tools, or more gradual than their development. They are perfectly consistent with the idea that the fabricators of them were in a condition closely verging upon that of the brutes. Apes are known to use stones in cracking the shells of nuts. The advantage to be derived from a pointed form, when it accidentally fell into the hand, would suggest itself almost instinctively to any being capable of profiting by experience and retaining it in the memory. Accidental fractures producing a sharp edge, would lead to fractures by design, and thus we may easily suppose that such implements as are represented in the first few figures on the sheet must necessarily have resulted from the very earliest constructive efforts of primeval man.

From the very first, a peculiar mode of fabrication appears to have been adopted, which consisted of chipping off flakes from alternate sides of the flint, and the facets thus left upon the flint, produce the wavelike edge which you will see in the side views of all the imple-

* I am informed by an eye witness, that the Australian savages, in climbing trees, use implements nearly similar to these, to cut notches for their feet. The implement is held in the hand, without any handle. Others are used in handles, either fastened with gum, or consisting of a withe passed round the stone and tied underneath.—A. L. F.

ments here represented. This method continued to be employed throughout the entire stone age in all parts of the universe, and is characteristic not merely of the drift, but of the cave, pfahlbauten, and surface periods.

The numerous intermediate gradations of form, whether between the oval, and the spear-head form, or between the thick, and the sharp-ended form, have been noticed by Sir Charles Lyell. By selecting specimens, and arranging them in order from left to right, I have endeavoured to trace the transition from the drift type, to the almond-shaped celt type, which latter is common to the stone age of mankind, whether ancient or modern, in all parts of the world.

Had the discovery of drift implements been confined to one locality or to one district, it is probable it would have attracted but little notice. As early as the first year of the present century the attention of the Society of Antiquaries had been drawn by Mr. Frere to the existence of these implements, in conjunction with the remains of the elephant and other extinct animals at Hoxne in Suffolk. An illustration of the specimens from this locality is given in figure 4. Mr. Frere described them as "evidently weapons of war, fabricated and used by a people who had not the use of metals." But little or no attention was paid to the subject until the discovery by M. Boucher de Perthes of precisely similar implements associated with the same class of remains, in the drift gravel of St. Acheul, near Amiens, in 1858.* Since then many other discoveries have been made, and still continue to be made, by Mr. Prestwich, Mr. Evans, Mr. Flower, Mr. Bruce Foote, and others, not only in this country but also in Asia and Africa, shewing, in so far as the discoveries have hitherto gone, that this drift type, like the almond celt type, is common to the earliest ages in all parts of the world, and that everywhere the drift type preceded the almond-shaped celt type, and is found in beds of earlier formation.

Figure 5 is a drift-shaped implement from the laterite beds of Madras, of exactly the same form as those found in England. Figure 6 is an implement of the same class from the Cape of Good Hope, found 14 feet from the surface. In America, implements of the drift type have not yet been discovered, but stone spear heads have been found in Missouri in connection with the elephant and other extinct animals. Figure 11 is from a mound of sun-dried bricks at Abou Sharein, in Southern Babylonia, obtained by Mr. J. E. Taylor, British Consul at Basrah; a cast of it, presented to me by Mr. Franks, is upon the table; it is a chipped flint; in form it is of the drift type, and its outline is precisely that of some of the Carib celts found in the West India Islands; it also closely resembles in form others from the Pacific,† its edge was evidently at the broad end. Another of the same type was found at Mugeyer in Babylonia, and a third closely resembling the two former was found in a cave in Bethlehem.

The celt type has not as yet been found in the French caves of the reindeer period, but it is common in the Pfahlbauten of the Swiss lakes.

* Mr. Frere's first discovery was in 1797.

† See figures 23 and 32, as well as figure 17A from Central India.

Some of the French cave specimens, however, closely approach the drift form, and in place of the celt, we have a peculiar kind of tool trimmed to a cutting edge on one side and having the other round for holding in the hand. As, however, these do not fall into the direct line of development, but may be regarded as a branch variety, I have not figured them on the sheet, but pass at once, though almost imperceptibly as regards form, from the drift to the surface type.

Figure 12 formed part of a large find of flint implements, discovered by myself in the ancient British camp of Cissbury, near Worthing—an account of this discovery was communicated by me to the Society of Antiquaries at the commencement of the present year. The period of these Cissbury implements must be fixed at a very much more modern date than those of the drift, with which they are associated on the sheet, having been found in conjunction with the earliest traces of domestic animals, such as the Bos longifrons, Capra hircus, and Sus; they may, however, be classed with the stone age, no trace of metal having been discovered with them, although from 500 to 600 flint implements were found in the camp. The peculiarity of the Cissbury find, however, consists in the discovery in the same pits in which celts of the type represented in figure 12 were found, of a few flints closely approaching the drift type, being thick at the broad end, and also of a large number resembling those found in the French caves trimmed to an edge on one side, and adapted to be held in the hand. So that the Cissbury find, although belonging to what is usually called the surface period, contains specimens affording every link of connection between the drift and the almond-shaped celt type. This discovery must, I think, be regarded as a step in knowledge of prehistoric antiquity, and a decided accession to the science of continuity, for Sir John Lubbock has told us in his preface to the work of Professor Nilsson, lately published,* that the Palæolithic, *i.e.*, the drift types, "have never yet been met with in association with the characteristics of a later epoch." I shall therefore be interested to know whether, after an examination of the Cissbury specimens, which I have presented to the Christy Collection, Sir John Lubbock may be induced to alter his opinion on that point; for I think it is entirely consistent with all that is known of early races of mankind, that early types should be retained in use long after the introduction of others that have been developed from them; however this may be, I think that in casting the eye from left to right along the upper row on the sheet (Plate xvii), it will puzzle the acutest observer to determine where the drift type ends and that of the celt begins. If it is contended, as I am aware it will be contended by some, that the typical characteristic of the celt consists in its being sharp at the broad end, while those of the drift are blunt at the broad end, I reply that many of the drift specimens are also sharpened at the broad end, more especially those represented in figures 9 and 10 from the drift of St. Acheul. Many specimens from Thetford which I have seen, as for example, Fig. 17 B, from a cast in the collection of the Society of Antiquaries, presented by Mr. Flower, approach

* "Nilsson on the Stone Age," edited by Sir John Lubbock. Editor's introduction, page 24.

equally closely to the celt type, as do some of those from the laterite beds of Madras, and though they are of rare occurrence in all these localities, and are certainly a variation from the normal type of drift implements, still they are found in sufficient numbers to serve as links in connecting the forms of the earliest, with those of the later period.

I have dwelt somewhat at length upon this part of my subject, owing to the circumstance of its presenting some features of novelty in the study of flint implements, and being therefore open to criticism on the part of those who are more favourable to the principles of classification than of continuity, with all the important concomitants of division, versus unity, which those principles involve.

I may now pass briefly over the remaining figures on the sheet. Figure 13 is a specimen found by Mr. Evans at Spienne, near Mons; its very close resemblance to figure 12 from Cissbury will be noticed, in fact the whole of the Spienne specimens resemble very closely those discovered in Cissbury, except that the Spienne implements of this class are associated with others of polished flint, which gives them a more advanced character than those derived from Cissbury, in which place only one fragment of a polished implement was discovered and that in a part of the intrenchment which renders it very doubtful whether it ought to be associated with the Cissbury find. Figures 15, 16, and 17 are from Denmark, Ireland, and Yorkshire;—this type, however, is rare in Denmark, most of the flint implements from that country being of a more advanced character, and having usually a rectangular cross section.

The lower row on the sheet consists of specimens derived, either from what has been termed the neolithic or polished stone age of Europe, or from savages who are still in a corresponding stage of progression in various parts of the world at the present time.

To the former or neolithic stone age of Europe belong figure 21 from France, figure 25 from the bed of the Clyde in Scotland, figure 27 from the Swiss lake dwellings, figure 29 from the caves in Gibraltar, figure 30 from Sweden, figure 36 from Portugal, figure 37 from the bed of the Thames, figure 38 from Ireland, figure 39 from Jelabonga, in Russia. Precisely identical forms are also found in Germany, Italy, and the Channel Isles. Amongst the specimens derived from the ancient stone age of other parts of the world, and belonging to an age of civilization that is now extinct, may be enumerated figure 22, from Peru, figure 40, from Mexico, figure 24, from Central India, figure 41, from Japan, figure 42, from Mugeyer, in Babylonia. Nearly similar ones, but flattened at the side, like those common in Denmark, have been obtained from China and Pegu. Figure 43 is from Algeria, from the collection of Mr. Flower.

The following are examples of the same class of implements, used by savages of our own, or of comparatively modern, times:—Figures 18 and 19 from Australia; these are generally used in a handle, formed by a withe twisted round them in the manner still used by blacksmiths in this country. Sometimes, however, I am informed by an eye-witness, the Australians use these celts in the hand without any handle at all. Although polished on the surface, these Australian

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celts have been compared by Sir Charles Lyell to the oval forms of the drift represented in figure 7. The art of polishing appears to have preceded the development of form in this country. Figure 20, from New Zealand, is a specimen in Mr. Evans's collection, of which he has been so kind as to allow me to take an outline; this form, however, is extremely rare in New Zealand, the usual shape of the stone celts from that country being flat sided, like the specimens from Denmark, already noticed. Figure 23, is from the Pacific, figure 26, from Pennsylvania, these were used by the American Indians previously, and for some time after, the immigration of Europeans. Figures 31 and 32 are Carib celts from my collection, beautifully polished. Figure 33, from St. Domingo, is in the Cork Museum. Figure 34, from the Antilles, is in the Christy Collection; both of these have a human face engraved upon them. Figure 35 is of Jade, from New Caledonia, in my own collection.

Hafting.

The method of hafting these implements employed by savages, shows that they were used for a variety of purposes; in some, the edge is fastened at right angles to the handle, to be used as an adze, whilst in others the same tool is fastened with the blade in a line with the handle, to be used as a chopper or battle-axe. In some it is fastened with a withe, passed round the stone, as in the specimen from Australia (fig. 44 from this Institution) and some parts of North America; figure 45 is a stone axe from the Ojibbeway Indians, from my collection. At other times it is inserted in the side of a stick or club. A specimen in my collection from Ireland (fig. 46), one of the few that have ever been found with handles, shows that this was the method employed in that country.* Others are inserted in the end of a bent stick (fig. 47), a mode of hafting common in the Polynesian Islands, in Africa, Ancient Egypt, Mexico, North America, and New Caledonia; it is employed by the Kalmucks, and others, and was used during the bronze age. Some of the Australian axes were fastened to their handles by a peculiar preparation of gum manufactured for that purpose.

Dr. Klemm, in his "Werkzeuge und Waffen," supposes the first lessons in hafting to have been derived from nature, by observing the manner in which stones are often firmly grasped by the roots of trees growing round them, and he gives several woodcuts of specimens of Nature's hafting, which he has collected from various sources; one of these, extracted from his work, is represented in figure 48. I have placed upon the table, in illustration of this idea, an iron Mediæval axe-head (fig. 49), which has furnished itself with a handle in this manner, whilst buried beneath the surface; it is said to have been found in Glemham Park, Suffolk, eleven feet from the surface. Even to this day, when a peasant in Brittany discovers one of these stone celts upon the ground, he is in the habit of splitting the branch of a young tree and

* The handle, since its discovery, has been fractured in four places, and has shrunk a good deal from its original size.—A. L. F.

inserting the celt into the cleft; in the course of a year or two it becomes firmly fixed, and he then cuts off the branch, and uses the implement thus hafted by nature as a hammer for driving nails. In the "Antiquités Celtiques et Antidiluviennes," volume I, page 327, M. Boucher de Perthes mentions the discovery of two ancient stone hammer-heads, which appeared to have been furnished with handles by passing the hole over the bough of a tree and allowing it to fill up the aperture by its natural growth, until it became firmly fixed as a handle.*

It might be interesting, if space permitted, to follow up the development of the stone axe-head through its various phases until, in the latest stages, when bronze had already come into general use for weapons, we find it furnished with a hole through the middle for the insertion of the handle. It may, I think, be safely said, that although nature furnishes numerous examples in many classes of rocks, and especially in flints, of stones perforated with holes, and although they appear to have attracted the notice of the Aborigines of many countries by the peculiar superstitious reverence which is often found to be attached to such stones when found in the soil, that this mode of fastening stone implements in their handles did not come into use until late in the stone age, and that even in the bronze age it was but little employed.

Transition from Oval to Rectangular Forms.

Whether the stone celt having a square or rectangular section (such as are found principally in Denmark, New Zealand, Mexico, and Pegu), was coeval, or of subsequent development, to those of the almond-shape type, may be a matter for conjecture; the small flint hatchets found in the Kitchenmiddens of Denmark, appear to approach closely to the rectangular type. It is certain, that in the Swiss Lakes both forms are found fully developed, and it may be mentioned, as an instance of the constant tendency to variation that is everywhere observable in the weapons of the early races of mankind, that of the whole of the celts found at Nussdorf, in the Lake of Constance, though all might be traced to the same normal type as regards their general outline, no two were alike; and Dr. Kellar gives sections, showing every conceivable gradation from the square and rectangular, to the oval and circular section.† It may, however, be affirmed, that convex forms, as a general rule, preceded those having a rectangular or concave surface; it is so in the forms of nature, the habitations of animals are almost invariably convex. Dr. Livingstone mentions, that he found it impossible even to teach the natives of South Africa to build a square hut; when left to themselves for a few minutes, they invariably reverted to the circle. All the earliest habitations of pre-historic times are found to be circular or oval; even the sophisticated infant of modern civilization, when he plays with his bricks,

* Horæ Ferales.

† "The Lake Dwellings of Switzerland," by Dr. Ferdinand Kellar, page 108.

will invariably build them in a circular form, until otherwise instructed.

Development of Spear and Arrow-head Forms (Plate XVIII).

We must now turn to the development of the second great class of weapons—the spear and arrow. These may be classed together, the arrow being merely the diminutive of the spear, and it may be taken as a general rule, applicable to all the arts of pre-historic times, that when a given form has once been introduced, it will speedily be repeated in every possible size that can be applied to any of the various purposes for which such a form is capable of being used. Size, in the arts of the earliest ages, is no indication of progress. In the same way it may be said of the development of the animal or vegetable kingdom, size is no indication of improved organism.

In the same beds in which the drift-type implements are found, flakes, either struck off in the formation of such tools, or especially flaked off from a core in a particular manner, indicating that they were themselves intended for use as tools, are found in considerable numbers. No more useful tool could have been used during the stone age than the plain, untouched, flint flake, which, from the sharpness of the edge, is capable of being used for a variety of purposes. Those, for example, formed of obsidian are so sharp, that it is recorded by the Spanish historians, that the Mexicans were in the habit of shaving themselves with such flakes. As my present subject has to deal exclusively with war weapons, I will not enter into a detailed description of these flakes, further than to observe that they are found, together with the cores from which they were struck off, in every quarter of the globe in which flint, obsidian, or any other suitable material has been found, and that everywhere the process of flaking appears to have been the same.

Now, the fracture of flint is very uncertain; by constant habit, the ancient flint workers appear to have been able to command the fracture of the flint in a manner that cannot be imitated, even by the most skilful forgers of those implements in modern times; but, notwithstanding this, the varieties of the forms of the flakes thus struck off must have been very considerable, and these varieties must, from the very first, have suggested some of the different forms of tools that were made out of them.

I cannot, perhaps, explain this point better, than by exhibiting a number of flakes, found by myself in the bed of the Bann at Toom, in Ireland, at the spot where that river flows out of Lough Neagh. This was a place originally discovered by Mr. Evans, where probably, in a habitation, built upon the river, they formerly manufactured flint implements, and the bed of the river for a space of a hundred yards or more is covered with the flakes. It will be seen on examining these flakes, that some of them came off in a broad leaf-shaped form, and these with a very little additional chipping, have been formed into spear heads. Others longer and thicker have been chipped into something like picks, and others thinner and narrower than the two former, have been used

probably as knives, others for scraping skins. We see from this that certain forms would naturally suggest themselves through the natural fracture of the flint, and this may to a certain extent account, though it does not, I think, entirely account, for the remarkable resemblance of form and unity of development, observable in the spear and arrow heads, derived from localities so remote from each other, as almost to preclude the possibility of their having ever been derived from a common source.

I have arranged in tabular form, upon sheet No. 2 (Plate xviii), representations of spear and arrow heads from all the different localities from which I have been able to obtain them in sufficient number, to show fairly the numerous varieties which each country produces. On the top of the sheet, from left to right, the several forms are arranged in the order that appears most truly to indicate progression; but it must not be supposed that this arrangement is absolutely correct, for the several forms, such for example as the tang and the triangular form, were most probably derived from a common centre. The specimens from each locality ought therefore, in order to display their progression properly, to be arranged in the form of a tree, branching from a common stem. On the left of the sheet are written the different periods, and localities from which the specimens are derived. Commencing with the drift, the oldest of which we have any knowledge, and which are coeval with the elephant and rhinoceros in Europe, we have the peculiar thick form already described. The examples of the drift period here shown, from their small size, must evidently have been used with a shaft, as they are scarcely large enough to have served as hand tools. None of the lozenge, tang, or triangular forms, have ever been found in the drift.

The next line represents specimens from the French caves of the reindeer period, which are taken from the "Reliquiæ Aquitanicæ," chiefly from Dordogne. It will be seen that in these caves, the first rude indications of the lozenge and tang form are represented, but no perfect specimens of either class. No example of the triangular form has been discovered. The leaf-shape form, however, is well represented.

In the ancient habitations of the Swiss Lakes, which belong to a later period, all varieties, except those of the drift type, are represented, but none of them in their most fully developed form; the tangs it will be seen are long, and the barbs comparatively short; the triangular form, which I consider to be the latest in the order of development, is mentioned by Dr. Kellar, from whose work these specimens are taken, as being extremely rare. The comparative rarity of flint implements in the Lakes, may however, in some measure be accounted for, by the absence of flint in the district, necessitating the importation of this material from a distance.

The specimens from Yorkshire, Ireland, Sweden, Denmark, Italy, and Germany, may be considered to carry the development of these forms up to the latest period, viz., the late stone, and early bronze age; for there can be no doubt from the number of arrow heads found in these countries, in connection with implements of bronze, that they

were used for missile purposes long after the "*armes blanches*" had been constructed of metal.

In all these localities, it will be seen that the various gradations of form are identical; but as I have been able to collect a much larger number of arrow heads from Ireland than elsewhere, the development of form is more apparent in the specimens selected from that country.

From the leaf shape, it will be observed, there is every link of transition into the perfect lozenge type, and the latter are as a general rule, both in Ireland and in Yorkshire, much rarer, and more carefully constructed, than the leaf-shaped type, showing that there is every probability of the lozenge having been an improved form.

The tang-form is represented, at first, by a few rude chips on each side of the base of the original flake, narrowing that part in such a manner, as to admit of its being inserted into a handle or shaft, and bound round with a sinew. This is superseded by the gradual formation of barbs on each side, and these barbs are lengthened by degrees, until they reach to the line of the base of the tang; the tang subsequently shortens leaving the barbs with a semicircular aperture between them, and thus approaching some of the forms represented in the triangular column. These latter barbed specimens are usually more finished, and chipped with greater care than the long tanged ones, which are rougher, more time-worn, and probably of earlier date.

The triangular form is seen at first, with a straight base; gradually a semicircular aperture appears, and this deepens by degrees until, in some of the more carefully formed specimens, it approached the form of a Norman arch. This last variety is especially well represented in Denmark.

Sir William Wild's arrangement, in his Catalogue of the Royal Irish Academy, differs in some respects from this; he considers the triangular an early form, and he assigns the final perfection of the art of fabricating flint spear heads, to the large lozenge-shape form, grounding his opinion on the circumstance of many of this form, of the larger size, having been found polished, whilst those of the leaf, triangular, and tang shape, are not usually carried further than the preliminary process of chipping. But it is evident that these larger forms may have been used for spears, the lozenge-shape being especially adapted for this purpose, as enabling the owner of it to withdraw it from the wound, after slaying his adversary; while those of the barbed and triangular form being lighter, and calculated to stick in the wound, would be better adapted for arrow heads—and it is unlikely that the same amount of labour would be expended on a weapon, intended to be cast from a bow, as upon one designed to be held in the hand. I consider the polishing of these particular weapons therefore to be no criterion of age, but merely to indicate that they were used as "*armes d'hast*," and not as missiles.

It appears highly probable, however, that all the several varieties, if not developed simultaneously, were used at the same time, for we find amongst the Persians, the Esquimaux, and many other nations,

that a great variety of arrow-heads are carried in the same quiver, and are used either indiscriminately, or for different purposes.*

In the eighth row from the top, I have arranged a series of similar forms from America, obtained chiefly from Pennsylvania, but they are also found in other parts of the Continent, and some few of the illustrations here given, viz., figures 131, 132, and 133 (Pl. xviii), are from Tierra del Fuego. Their forms enable them to be arranged under precisely the same divisions, as those from the continent of Europe, and in each division the same development is observable. The tang or barbed form, however, differs sufficiently from the European forms of the same class, to show that they arose independently, and were not derived from a common source. The tang of the American arrow heads, it will be seen, is broader, at least in the later forms, and it appears to have originated in a notch on the sides of the blade, intended to hold the sinew with which it is attached to the shaft or handle. This notch appears to have been constructed lower and lower on the sides of the blade, until at last it comes down quite into the base of the flint, and it then closely resembles the European in form; compare for example figures 94 and 136, Plate xviii; except that the tang is broader, and has a lateral proportion on each side, so as to render it firmer in the shaft when bound by the sinew.

Notches at the side of the blade are extremely rare in Ireland, but from Sweden, Professor Nilsson gives a drawing of an arrow-head, which I have copied on to the sheet, see Fig. 96 (pl. xviii). It is precisely identical, in its peculiar form, to one here figured from America Fig. 139 (pl. xviii), and they both have a concave base, in addition to the side notch; thus apparently representing a transition form between the tang and the triangular, which I have never noticed, except in the two specimens here referred to, and which must be regarded in Europe as extremely rare.

To illustrate the mode of fixing these instruments in their shafts, I have here figured several examples from my collection, two of these Figs. 163 and 164 (pl. xviii), were derived from the Esquimaux, between Icy Cape and Point Barrow, the person from whom I purchased them having brought them himself from that locality. Figures 165, 166, and 167 (pl. xviii), are from California.

Burton says that the Indians between the Mississippi and the Pacific use the barbed form only for war; and Schoolcraft, in the "Archives of the Aborigines of America," gives illustrations of two methods of fastening, one for war and the other for the chase, the former being loosely tied on, so as to come off when inserted in the wound.

But, in addition to their use as arrow points, we have reason to suppose that they were used also as knives. I have represented on this sheet Figs. 168 and 169 (pl. xviii), two short-handled instruments from Peru, which are now in the British Museum, into which similar arrow

* After having witnessed the process of fabricating flint arrow heads, as re-discovered by Mr. Evans, I am able to understand why it is that the leaf-shaped form is of more frequent occurrence, and why this and the long-tanged forms are so often rougher and less finished than the other forms, the deep barbs and hollow base requiring much greater skill than the former.—A. L. F.

points are inserted. These, from the shortness and peculiar shape of their shafts, could hardly have been used as darts. The only weapon peculiar to those regions from which such an instrument could have been projected, is the blow-pipe, and they are entirely different from the darts used with the blow-pipe, either in South America, the Malay Peninsula, or Ceylon, in which countries the blow-pipe is used. There is reason to believe, from the manner in which they are placed in the graves unaccompanied by any bow or other weapon from which they could have been projected,* that they were employed as knives, and this is confirmed by the fact already mentioned of the inhabitants of Tierra del Fuego using their arrow points for knives. The great numbers in which they are found in Ireland, in Yorkshire, and other localities appertaining to the late stone age, in which places they form the greater part of the relics collected, and are always the most highly finished implements discovered; the other stone implements associated with them being either celts, flint-discs, picks, or rough or partially worked flakes, that are capable of being wrought into arrows, the fact that the peculiar modification of form observable at the base of these implements appears to have been designed rather to facilitate the attachment of them to their wooden shafts or handles, than for the special purposes of war; and the frequent marks of use, as if by rubbing, that are found on the points of many of them, especially in the specimens from Ireland; all these circumstances favour the supposition that in Europe, as well as in America, these arrow-head forms were used for many other purposes besides war and the chase; and that, like the assegai of the Caffre, and the many other examples of tool weapons already enumerated, we may regard them as having served to our primeval ancestors the general purposes of a small tool available for carving, cutting, and for all those works for which a fine edge and point was required. On the other hand the celt undoubtedly provided them with a large tool capable of being applied to all the rougher purposes, whether peaceful or warlike, for which it was adapted in the simple arts of an uncivilized people.

In the ninth row I have arranged, under their respective classes, the whole of the specimens of flint arrow heads that are given in Siebold's atlas of Japanese weapons.† It will be seen that they present the same variety of form as those already described. A similar collection of flint arrow heads has lately been added to the British Museum, by Mr. Franks and described by him. They formed part of a Japanese collection of curiosities, and are labelled in the Japanese character, showing that this remote country not only passed through the same stone period as ourselves, but that, as their culture improved and expanded, they, like ourselves, have at last begun to make collections of objects to illustrate the arts of remote antiquity.

* In the museum belonging to the Cork College, there is a Peruvian mummy, with which, amongst other articles, two of these arrow-pointed knives were found.—A. L. F.

† Siebold, Nippon, Alte Waffen.—Tab. xi.

Implements composed of Perishable Materials.

It is now time that I should say a few words respecting weapons constructed of more perishable materials; for it is not to be assumed that, because we find nothing in the drift-gravels but weapons of flint and stone, the aborigines of that age did not also employ wood and other materials capable of being more easily worked. If man was at that time, as he is now, a beast of prey, he must also have become familiar in the very first stages of his existence, with the uses of bone as a material for fabricating into weapons. In the French caves, a large number of bone implements have been found, and their resemblance, amounting almost to identity, with those found in Sweden, amongst the Esquimaux, and the inhabitants of Tierra del Fuego, has been noticed by Sir John Lubbock, Professor Nilsson, and others.

But, in dealing with the subject of continuity and development, it is necessary to confine our remarks to those countries from which we have had an opportunity of collecting large varieties of the same class of implement; we must therefore have recourse to the Australian, the New Zealander, and those nations with which we are more frequently brought in contact.

Transition from Celt to Paddle, Spear, and Sword Forms (Plate XIX).

The almond-shape celt form, as I have already demonstrated, is one so universally distributed and of such very early origin, that we may naturally expect to find many of the more complicated forms of savage implements derived from it. In a paper in the "Ulster Journal of Archæology," for 1857, a writer draws attention to the occurrence in the bed of the Bann, and elsewhere in the north of Ireland, of stone clubs, formed much upon the general outline of the celt, but narrowed at the small end, so as to facilitate their being held in the hand like a bludgeon. Fig. 50 is copied from the illustration given in the paper referred to, and fig. 51 is another in my collection, also from Ireland, of precisely the same form; the original is upon the table, and it will be seen that it is simply a celt cut at the small end, so as to adapt it to being held in the hand. Fig. 52 is an implement in common use among the New Zealanders, called the pattoo pattoo, of precisely the same shape; it is of jade, and its form, as it may be seen by the thin sharp edge at the top, is evidently derived from that of the stone celt. Fig. 53 is a remarkably fine specimen, from the museum of this Institution; the handle part in this specimen is more elaborately finished. These weapons are used as clubs to break heads, and also as missiles, and the fact of their having been derived from the celt is shown by the manner in which they are used by the New Zealanders. I am informed by Mr. Dilke, who derived his information from the natives whilst travelling in New Zealand, that the manner of striking with these weapons is not usually with the side, but with the sharp end of the pattoo pattoo, precisely in the same manner that a celt would be used if held in the hand. The spot selected for the blow is usually above the

ear, where the skull is weakest. If any further evidence were wanting to prove the derivation of this weapon from the stone celt, it is afforded by fig. 54, which is a jade implement lately added to the British Museum, from the Woodhouse Collection. It was, for some time, believed to have been found in a Greek tomb, but this is now believed by Mr. Franks to be a mistake; it is, without doubt, a New Zealand instrument. The straight edge shows unmistakably that the end was the part employed in using it, while the rounded small end with a hole at the extremity, shows that, like the pattoo pattoo, it was held in the hand. It is, in fact, precisely identical with the hand celts from Ireland, above described, and forms a valuable connecting link between the celt and pattoo pattoo form. Now it may be regarded as a law of development, applicable alike to all the implements of savage and early races, that when any form has been produced symetrically, like this pattoo pattoo, the same form will be found either curved to one side, or divided in half (the variation, no doubt, depending on the purposes for which it is used). The pattoo pattoo having been used at first, like its prototype the celt, for striking with the end, would naturally come to be employed for striking upon the side edge.* The other side would therefore be liable to variation, according to the fancy of the workman. Figs. 55, 56, and 57, are examples of these implements, in which the edge is retained only on one side, and at the end, the other side being variously cut and ornamented. This weapon extended to the west coast of America, and there, as in New Zealand, they are found both of the symmetrical and of the one-sided form. Fig. 58 is one believed to be from Nootka Sound, in my collection. Fig. 59 is also from Nootka, in the museum of this Institution. Fig. 60 is an outline of one from Peru, which is figured in Dr. Klemm's work, and I am informed that a nearly similar club has been derived from Brazil.

The same form as the pattoo pattoo, in Australia has been developed in wood. Fig. 61 is from Nicol Bay, North West Australia, and is in the Christy Collection described as a sword. Fig. 62 is of the same form, also of wood, but of cognate form, from New Guinea. In fig. 63, which is also from New Guinea, we see the same form developed into a paddle. In the larger implements of this class we see the same form, modified in such a manner as to diminish the weight; thus, the convex sides become either straight or concave. I have arranged upon the walls a variety of clubs and paddles, from the Polynesian Islands, figs. 64 to 67, all of which must have been derived from a common source. The New Zealand steering paddle, fig. 64, it will be seen, is simply an elongated celt form. Those from the Marquesas (fig. 65), Society Isles, Fiji, and Solomon Isle, &c., are all allied. In the infancy of the art of navigation, we may suppose that the implements of war, when constructed of wood, may have frequently been used as paddles, or those employed for paddles have been used in the fight, and this may perhaps account for the circumstance that, throughout these regions, the

* Evidence of this transition may be seen by examining any number of pattoo pattoos. Some are sharp at the end, others are blunt at the end, but sharp at the side near the broadest part.—A.L.F.

club, sword, and paddle pass into each other by imperceptible gradations. In the Friendly Isles we may notice a still further development of this form into the long wooden spear, specimens of which, from this Institution, are exhibited (figs. 68, 69, and 70).

We must not expect to find all the connecting links in one country or island. We know that the same race has at different times spread over a very wide area; that the Polynesians, New Zealanders, and Malays are all of the same stock, speaking the same or cognate languages. The same race spread to the shores of America on the one side, and to Madagascar on the other, carrying with them their arts and implements, and we may, therefore, naturally expect that the links which are missing in one locality, may be supplied in another.

Development of the Australian Boomerang (Plate XX).

We now turn to the Australians, a race which, being in the lowest stage of cultivation of any with whom we are acquainted, must be regarded as the best representatives of the aboriginal man.

I have transferred the Australian sword, figured in Plate xix, fig. 61, to Plate xx, fig. 72, in order that from it we may be able to trace the development of a weapon supposed by some to be peculiar to this country, but one which in reality has had a very wide range in the earliest stages of culture—I allude to the boomerang.*

The Australians in the manufacture of all their weapons, follow the natural grain of the wood, and this leads them into the adoption of every conceivable curve. The straight sword would by this means at once assume the form of the boomerang, which it will be seen by the diagram is constructed of every shade of curve from the straight line to the right angle, the curve invariably following the natural grain of the wood, that is to say, the bend of the piece of a stem or branch out of which the implement was fabricated.

All savage nations are in the habit of throwing their weapons at the enemy. The desire to strike an enemy at a distance, without exposing one's self within the range of his weapons, is one deeply seated in human nature, and requires neither explanation nor comment. Even

* Since this paper was read to the Institution, Sir John Lubbock has delivered a remarkably interesting series of lectures on savages at the Royal Institution; in the course of which he took exception to my classification of the Indian, African, and Australian boomerangs, under the same head; giving as his reason, that the Australian boomerang has a return flight, whilst those of other nations have not that peculiarity. If it could be shown that the Australian weapon had been *contrived* for the purpose of obtaining a return flight, I should then agree with him in regarding the difference as generic. But the course of my investigations tends to show that this was probably an application of the weapon accidentally hit upon by the Australians, and that it arose from a modification of weight and form, so trivial, as to prevent our regarding it as generically distinct from the others. I therefore consider the Australian weapon to be a mere variety of the implement which is common to the three continents. The difference between us on this point, though one of terms, is nevertheless important as a question of continuity. I am much gratified, however, to find my opinions on many other points, supported by Sir John's high authority.—A.L.F.

apes, as I have already noticed, are in the habit of throwing stones. The North American Indian throws his tomahawk; the Indians of the Gran Chako, in South America, throw the "macana," a kind of club. We learn from the travels of Mr. Blount,* in the Levant in 1634, that at that time the Turks used the mace for throwing, as well as for striking. The Kaffirs throw the knob kerry, as did also the Fidasians of Western Africa.† The Fiji Islanders are in the habit of throwing a precisely similar club. The Franks are supposed to have thrown the francisca.‡ The New Zealander throws his pattoo pattoo, and the Australian throws the "dowak" and the waddy, as well as his boomerang. All these weapons spin of their own accord when thrown from the hand. In practising with the boomerang, it will be found that it does not require that any special movement of rotation should be imparted to it, but if thrown with the point first it must inevitably rotate in its flight. The effect of this rotation, it will hardly be necessary to remind those acquainted with the laws of projectiles, is to preserve the axis and plane of rotation parallel to itself, upon the principle of the gyroscope. By this means the thin edge of the weapon would be constantly opposed to the atmosphere in front, whilst the flat sides, if thrown horizontally, would meet the air opposed to it by the action of gravitation; the effect, of course, would be to increase the range of the projectile by facilitating its forward movement, and impeding its fall to the earth. This much, all curved weapons of the boomerang form possess as a common property.

If any large collection of boomerangs from Australia are examined, it will be seen that they vary not only in their curvature, but also in their section; some are much thicker than others, some are of the same breadth throughout, whilst others bulge in the centre; some are heavier than others, some have an additional curve so as to approach the form of an S, some have a slight twist laterally, some have an equal section on both sides, while others are nearly flat on one side and convex on the other.

As all these varieties continued to be employed, it would soon be perceived that peculiar advantages were derived from the use of the flatter class of weapon, especially such as are flat on the under side, for by throwing these in such a manner as to catch the air on the flat side, instead of falling to the ground, they would rise in the air, precisely in the same manner that a kite (fig. 71), when the boy runs forward with the string, rises and continues to rise as long as it is kept up by the action of the air beneath. In like manner the boomerang, as long as the forward movement imparted to it by the thrower continues, will continue to rise, and the plane of rotation, instead of continuing perfectly parallel to its original position, will be slightly raised by the action of the atmosphere on the forward side. When the movement of transition ceases, the boomerang will begin to fall, and its course in falling will be by the line of least resistance, which is in the direction of the edge that lies obliquely towards the thrower; it

* "Voyage into the Levant," by Henry Blount, Esq., 1634.
† Basman's Guinea. ‡ Horæ Ferales.

will therefore fall back in the same manner that a kite, when the string is suddenly broken, is seen to fall back for a short distance, but as the kite has received no movement of rotation to cause it to continue in the same plane of descent, it soon loses its parallelism, and falls in a series of fantastic curves towards the ground. The boomerang will do the same thing if it loses its movement of rotation, but as long as this continues, which it usually does after the forward movement has ceased, it continues to fall back upon the same inclined plane by which it ascended, and finally reaches the ground at the feet of the thrower. There are various ways of throwing the boomerang, but the principles here enunciated will explain the course of its flight in whatever manner it may be thrown.

Now it is evident that this peculiar mode of flight would be of great advantage to the savage, for as we learn from a paper in the Transactions of the Ethnological Society by Mr. Oldfield, who speaks from experience, the natives usually employ this weapon against large flocks of ducks or wild fowl in rivers or marshes; the weapon after striking or missing the prey would return to the thrower, instead of being lost in the morass; its use, therefore, would give to the individual or tribe possessing it, a great advantage over their neighbours in the struggle for life.

But it is evident that the principles of the flight of the boomerang, such as I have described it, according to the recognized law of projectiles, must have been entirely unknown to the savage; he can no more be said to have *invented* the boomerang than he can be said to have *invented* the art of sustaining life by nourishment. Instinct prompts him to eat, little better than instinct would enable him to select from amongst his weapons such as are found most suitable for obtaining food, and we have already seen how he may have been led to the adoption of such an instrument as the boomerang, purely through the laws of accidental variation, guided by the natural grain of the material in which he worked.

The boomerang, though used chiefly for game, is used also as a weapon, and Mr. Oldfield says that it is capable of inflicting a wound several inches in depth.

A further improvement is effected in the flight of the boomerang by giving the arms a slight lateral twist, by means of which it is caused to rise by virtue of its rotation, screwing itself up in the air precisely in the same manner that a boy's flying top rises to the ceiling. By means of this addition, the weapon is sometimes made to strike an object in its fall to the ground, behind the thrower, but the twist is not by any means invariable, as any one may see by examining a collection of these weapons. Nor is it essential to ensure a return fall, which I have frequently ascertained by practising with a boomerang that was perfectly flat.

On examining the diagram on sheet 4 (Plate xx), it will be seen that the boomerang passes by imperceptible gradations from the straight sword, fig. 72, on the one hand, into the "malga" or kind of pick, fig. 89, used for war purposes on the other,* and this Australian malga closely resembles a

* This weapon is called "leowel" by the Australians now in this country.—A. L. F.

weapon of the same kind from New Caledonia, figs. 90 and 91, which, as already mentioned, is used both as a weapon and for tilling the ground. Upon sheet No. 5 (see Plate xx), figs. 92 to 100, I have also arranged the links of connection between the boomerang and a kind of hatchet or chopper called the waddy. A slight swell or projection is seen to grow out of one end of the concave side of the boomerang, and this developes into the form of a chopper. In those specimens of this class, in which the projection is only slightly developed, as in figs. 94 and 95, the sides of the implement are flat, and the weapon is obviously designed for throwing, but in some of those in which the projection is more fully developed, as in fig. 96, the shaft is quite round, and the head becomes thick and heavy, so as to render it totally unsuited to the purposes of a missile. We see, therefore, in these diagrams the transition, by minute gradations, from a missile to a hand weapon, or *vice versâ*. The boomerang, the sword, the malga, and the waddy, are thus seen to be allied in such a manner as to make it difficult to determine which of the four was the original weapon, and, if properly arranged to display their development, they should be distributed in branch lines, starting from a common centre, exactly in the same manner that I have suggested the various forms of spear and arrow heads ought to be arranged in the natural order of progression.

Indian Boomerangs (Plate XX).

On sheet No. 6 (Plate xx), figs. 101 to 105, I have arranged a series of boomerangs from India. Figures 101 and 102 are specimens of the "katureea" or boomerang of Goojerat, from the India Museum; they are used by the koolees, according to the ticket in the Museum, "for whirling at hares, boars, and other wild animals, and disabling them." It is of raen wood, thicker and heavier than the Australian specimens, and therefore not adapted to rise in the air and return. The section is equal on both sides, but in other respects it is precisely identical with the Australian weapon, and appears to have been roughly chipped into form. Figures 103 and 104 are of an improved form, from Madras, called the collery, also of wood, but having a knob at the handle end; they are from the Museum of this Institution. Figure 105 is precisely the same form in steel, from the India Museum. It is probable that this weapon led to the use of the steel "ckakkra" or war quoit (fig. 106) of which I have given an illustration from the Museum of this Institution. The principle of its flight is precisely that of the boomerang, in so far as regards the increase of range and velocity produced by the rotation preserving the thin edge in the line of its forward motion. The earliest mention of this instrument is in the description of the Malabar Coast, by Magellan, about 1512, translated by Mr. Stanley, for the Hakluyt Society. The author describes amongst the arms used in the kingdom of Dely, certain wheels called chacarani, "two "fingers broad, sharp outside like knives, and without edge inside, "and the surface of these is of the size of a small plate, and they "carry seven or eight of these each, put on the left arm, and they

"take one and put it on the finger of the right hand, and make it spin "round many times, so that they hurl it at their enemies, and if they "hit any one on the arm or neck, it cuts through all, and with these "they carry on much fighting, and are very dexterous."* These weapons are usually worn on the head, but the circumstance here mentioned of their being worn on the arm, reminds us very much of the peculiar weapon worn by the Djibba negroes of Central Africa as a bracelet; this is represented in figure 107; it is of iron, sharp on the outside and blunt on the inside, which touches the arm; the edge is usually covered with a strip of hide to prevent injury to the person. I am not aware that this weapon of the negroes is ever used as a missile, but the occurrence of two such singular weapons, similarly carried, is worthy of notice, more particularly as we have clear evidence of a connection between the metal workers of the whole continent of Africa and the hill tribes of Central India.

It is possible that many links of connection may be supplied when the subject of continuity comes to be more carefully studied in these countries. It would appear extremely probable that the small Koorkeree and Goorkah knife, though now used only for hand fight, may have had their origin in these missile weapons, which they resemble in form, especially the large Goorkah knife. It would be interesting to know if they are ever thrown. I have heard stories of this having been the case, but no authentic account of such a practice. The Spaniards throw their long clasp knives with effect for a considerable distance.

African Boomerangs (Plate XX).

Turning to Africa (Plate xx), we find the boomerang well represented in many parts of that continent. Figure 108 is an ancient Egyptian boomerang of wood, in the British Museum. It was obtained from the collection of James Burton Junior, Esq., which was formed by him in Egypt, and is described as "an instrument for fowl- "ing, for throwing at, or knocking down birds, as is continually repre- "sented on the walls of the tombs." It is of hard but light wood, the section is symmetrical on both sides, and not flat on one side, like some of the Australian boomerangs; it is somewhat broader at the ends than in the middle of the blade. Figures 109, 110, and 111, are taken from Rosellini's Egyptian Monuments, and show how this instrument was used by the ancient Egyptians. Sir Samuel Baker has described the weapon called the "trombash," used in those parts of Abyssinia which he traversed.† It is of hard wood, resembling the Australian boomerang, about two feet in length, and the end turns sharply at an angle of 30°; they throw this with great dexterity, and inflict severe wounds with the hard and sharp edge, but, unlike the boomerang, it does not return to the thrower. Figure 113 is a wooden instrument, in the Christy Collection, said to be used by the Djibba

* Coasts of East Africa and Malabar, by Magellan, translated for the Hakluyt Society by the Honorable H. Stanley, p. 101.

† Nile Tributaries of Abyssinia, Baker, p. 511.

negroes for throwing at birds. Figure 114 is the Nubian sword, which in form exactly resembles the boomerang. They have a great variety of curves, some of them, especially those of the same form used in Abyssinia, bending nearly in a right angle. I am not aware that this instrument is ever thrown by the Nubians; they, however, are in the habit of throwing their curved clubs with great dexterity. Figure 115 is an iron implement of native workmanship, used as a missile by the inhabitants of Central Africa; it was brought from that region by Consul Petherick, at whose sale I purchased it. Like the majority of the succeeding figures represented on this sheet, it resembles the Australian boomerang, in being flat on the under side, that is to say, upon the side which would be undermost, if thrown from the right hand with the point first; the weight, however, would prevent such a weapon from rising in the air, or returning to the thrower. Figure 116 is used by the Mundo tribe of Africa; like the last, it is flat on the under side; in form it resembles the falchion, represented in the Egyptian sculptures as being held in the hand by Rameses and other figures, when slaying their enemies. The small knob on one side of the blade is used to attach it to the person in carrying it. Figure 117, from Central Africa, is clearly a development of the preceding figure. Figure 118 is a weapon of the same class, from Kordofan, obtained near the cataracts of Essoan, Upper Nile, and now in the Museum of this Institution; though of the same character as the other missiles, its section is equal on both sides, and therefore it is not calculated to range far in its flight. Figure 119 is also from the Museum of this Institution, it is flat on the under side. Figures 120 and 121 are from illustrations in Denham and Clapperton's Travels in Northern and Central Africa, of the missile instruments, called "hunga-mungas," used by the negro tribes, south of Lake Tchad. One of these is of very peculiar form; in the course of the innumerable variations which this weapon appears to have undergone, the constructor appears to have hit upon the idea of representing the head and neck of a stork. Figure 122 is from a sketch in Dr. Barth's Travels, of one of these weapons, belonging to the Marghi, a negro tribe in the same region; it is called "danisco," and he says that the specimen here represented is of particularly regular shape, thereby inferring that numerous varieties of form are in use among these people. In another place, he describes the "goliyo" of the Musqu and the "njiga" of the Bagirmi, as weapons of the same class, the name of the latter differing from the word for spear, only in a single letter; he says this weapon is common to all the pagan, *i.e.*, negro tribes that he came across*. Figure 123 is from East Central Africa, presented to the Christy Collection by the Viceroy of Egypt: it is described as a cutting instrument, from the country of the Dinkas and Chouloukes, capable of being thrown to a great distance. Mr. Petherick met with these tribes in his travels on the White Nile. Figure 124 from my collection, is described as a battle-axe of the Dor tribe, between the equator and the 6th or 7th degree of north latitude. It

* Barth's Travels in Africa, vol. iii, pages 231, 451, &c., &c.

was brought to England by Mr. Petherick, who obtained it in his travels in 1858; it is used also for throwing. Figure 125 is from an illustration in Du Challu's work, of the missile tomahawk, used by the Fans in the Gaboon, in West Central Africa; he says that the thrower aims at the head, and, after killing his victim, uses the round edge of the axe to cut off the head. We see from this, that notwithstanding the innumerable and apparently meaningless variations which this weapon has undergone, the different parts of it are sometimes applied to especial uses. Figure 126 is another missile, used by the Neam Nam tribes, East Central Africa. Mr. Petherick says, that the Baer tribe carry a different kind of iron missile from the Neam Nams. Figures 126 to 129, are different varieties of Neam Nam weapons, in which, as they are all derived from the same people, the gradual transition of form is more perceptible than in those isolated specimens derived from different tribes. If, however, we had specimens of all the varieties used by each tribe, we should without doubt be able to trace the progression of the whole of them from a common form. As it is, the connection is sufficiently obvious when the details are examined, throughout the whole region in which they are found, extending from Egypt and the Nile in the East, to the Gaboon on the West Coast. In all, the principle of construction is the same, the divergent lateral blades serving the purpose of wings, like the arms of the Australian boomerang, to sustain the weapon in the air when spun horizontally. The variations are such as might have resulted from successive copies, little or no improvement being perceivable in the principle of construction throughout this region notwithstanding the innumerable forms through which it must have passed during its transmission from its original source, the locality of which we shall probably be unable to determine, until the antiquities of the country have been more carefully described and studied. As, however, it is everywhere found in the hands of the negro aborigines of the country, it must probably have had the same origin as the arts of smelting and fabricating iron, which is everywhere identical throughout this region, and is, without doubt, of the remotest antiquity, dating long prior to any historical record of the continent of Africa.

Cateia.

The possible employment of the boomerang in Europe has been made the subject of occasional speculation amongst antiquarian writers. Having been used in Egypt, and perhaps in Assyria, there is no good reason for doubting that it may have spread from thence to the north west. In a learned paper on the subject, by Mr. Samuel Ferguson, in the 19th volume of the Transactions of the Royal Irish Academy, the author endeavours to prove that the cateia mentioned by classical authors was the boomerang. He quotes several passages, and amongst them one from the Æneid of Virgil, in which mention is made of a people accustomed to whirl the cateia, after the Teutonic manner. In the Punics of Silius, one of the Lybian tribes who accompanied Hannibal to Italy, is described as being armed with a bent or crooked

cateia. Isidore, bishop of Seville, a writer of the end of the sixth and beginning of the seventh century described the cateia as "a species "of bat, which, when thrown, flies not far, by reason of its weight, "but where it strikes, it breaks through with extreme impetus, and if "it be thrown with a skilful hand, it returns back again to him who "dismissed it."

Strabo also describes the Belgæ of his time, as using "a wooden "weapon of the shape of a grosphus, which they throw out of hand, "and which flies faster than an arrow, and is chiefly used in the pursuit "of game."

General Conclusions relative to the Boomerang.

Those who desire further information relative to its supposed use in Europe, cannot do better than refer to the paper from which I have quoted. Meanwhile, enough has been said to show:—1stly, that the boomerang was used in many different countries at a very early period, and in a very primitive condition of culture, and that it was everywhere employed chiefly in the pursuit of game; 2ndly, that it was everywhere constructed of wood, before it was copied in metal; 3rdly, that in Australia it originated as a variety of the almond or leaf-shaped sword, and was suggested by the natural curvature of the material out of which it was formed; 4thly, that the subsequent improvements by which its return flight was insured, arose from a practical selection of suitable varieties, and was not the result of design, and,—5thly, that the form of the boomerang passes by minute gradations, into at least three other classes of weapons in common use by the same people, and may therefore be regarded as a branch variety of an original normal type of implement, used by the most primitive races as a general tool or weapon.

Development of the Club (Plate XXI).

Amongst other implements used for war, the form of which appears to be derived from the same common source as those already described, may be included the Australian club, and the wamera or throwing stick. I have arranged upon sheet, No. 8 (Plate xxi), figs. 130 to 137, a series of Australian clubs, showing a transition from the plain stick of equal size throughout, to one having a nearly round knob at one end. Nearly similar forms to some of these, from Africa, figs. 138 to 140, are also represented on the same sheet.

Contrivances for Throwing the Spear (Plate XXI).

Amongst the Australian wameras, there are so many varieties, that it is next to impossible to speculate upon the priority of any particular form, unless the plain stick, with a projecting peg at one end, may be regarded as, certainly the simplest, and therefore the earlier form. The wamera is held in the right hand, and the projecting peg at the end is fitted into a cavity at the end of the spear, which latter is held

in the left hand, in the required direction, until just before the moment of throwing. The spear is then impelled to its destination by the wamera, which gives great additional impetus to the arm. Fig. 147 is a wamera from Nicol Bay, of exactly the same general outline, as the sword already figured, from that locality, figs. 61 and 62 (Plate xix), except that one of the faces at the end of which the peg is fastened, is concave, and the other convex; this specimen is in the Christy Collection. The wamera assumes a great variety of forms, some, as for example, fig. 142, resemble on a small scale the New Zealand paddle, the broad end being held in the hand, and the peg inserted in the small end; others broad and flat, figs. 148 to 150, bulge out in the middle by successive gradations, until they approach the form of a shield. No reasonable cause that I am aware of, can be assigned for these different forms, beyond caprice, and the action of the law of incessant variation, which is constant in its operation amongst all the works of the aborigines.

The wamera is found on the north-west* and south-west† coasts of Australia, and Major Mitchell describes it, in the east and central parts of the Continent.‡

That the wamera preceded the bow, appears probable from the fact that no bow is ever used in Australia, unless occasionally upon the north coast, where it is derived from the Papuans. The bow is not indigenous in New Zealand, or in any of those islands of the Pacific, which are peopled by the Polynesian race, it belongs truly to the Papuans, and where it is used elsewhere in the Pacific Islands as a toy, it may very probably have been derived from their Papuan neighbours. The throwing sticks are used in New Zealand, in which country Mr. Darwin describes the practice with them. "A cap," he says, "being fixed at "30 yards distance, they transfixed it with the spear delivered by "the throwing stick with the rapidity of an arrow from the bow of a "practised archer."§ In New Guinea, Captain Cook saw the lance thrown 60 yards, as he believed, by the throwing stick. I saw the Australians, now exhibiting on Kennington common, throw their spears with the wamera nearly 100 yards extreme range, but as they practised only for range, I had no opportunity of observing the accuracy of flight. Mr. Oldfield says that their practice has been much exaggerated by the European settlers, in order to justify acts on their part, which would otherwise appear cowardly. He says, that a melon having been put up at a distance of 30 yards, many natives practised at it for an hour without hitting it, after which an European, who had accustomed himself to the use of this weapon, struck it five times out of six with his spear. Klemm, on the other hand, has collected several accounts of their dexterity in the use of it; he says, that the range is

* Gregory's Account of his Expedition in 1861, vol. xxxii, Royal Geographical Society's Journal.

† A. Oldfield, Esq., on "Aborigines of Australia." Transactions Ethno. Soc., vol. iii.

‡ "Expedition to the Interior of Eastern Australia," by Major T. L. Mitchell, Surveyor-General, Geographical Society's Journal, vol. ii.

§ Darwin, Naturalist's Journal.

90 yards, and mentions that Captain Phillips received a wound several inches deep at 30 paces. At 40 paces he says, the aborigines are always safe of their mark. A sharp flint is usually fixed with gum into the handle of the wamera, which they use for sharpening the points of their spears.

The throwing stick (fig. 151) is used by the Esquimaux throughout the regions they inhabit. Frobisher mentions it on the east, Captain Beachey on the north west, and Crantz describes its use in Greenland. Klemm says, that the throwing stick used in the Alleutian Isles, differs from that of the Greenlander in having a cavity, to receive the end of the spear, instead of a projecting tang. The Esquimaux stick generally differs from the Australian in form, and has usually holes cut to receive the fingers, which by this means secure a firm grasp of the instrument. The custom of forming holes or depressions in an implement to receive the fingers was very widely spread in pre-historic times. I have specimens of stones so indented, used probably as hammers, from Ireland, Yorkshire, Denmark, and Central India. In the Christy Collection there is one precisely similar from the Andaman Isles.

The only other race that is known to make use of the throwing stick is the Purus Purus Indians of South America, inhabiting a tributary of the Amazon. These people have no bow, and in many other respects resemble the Australians in their habits. Their throwing stick is called "palheta;" it has a projection at the end, to fit into the end of the spear, and is handled exactly in the same manner as the Australian wamera.*

Another kind of spear thrower, consisting of a loop for the finger and a thong by which it is fastened to the spear, is used in New Caledonia and Tanna, New Hebrides (fig. 152). On ordinary occasions this is carried by being suspended to an armlet on the left arm, but, when preparing for war, they fasten it on to the middle of their spears. I exhibit here, fig. 153, a precisely similar contrivance from Central Africa, from my collection. Judging by the spiral ferrule at the end of the lance, to which it is attached, it appears to be derived from Central or East Central Africa. This mode of increasing the range of the dart or javelin was well known to the ancients, and was called by the Greeks ἀγκύλη, and by the Romans "amentum;" it is represented on the Etruscan vases,† and is figured in Smith's "Dictionary of Greek and Roman Antiquities," from which the drawing given in fig. 154 is taken. One of the effects produced by this contrivance was, doubtless, to give the weapon a rotary motion, and thereby to increase the accuracy of its flight, upon the same principle as the rifling of a bullet; but the range and velocity were also increased, by enabling the thrower, the tip of whose forefinger was passed through the loop of the "amentum," to press longer upon the spear, and thus impart a greater velocity to it, in the same manner that the effect of the Australian wamera may be said to increase the length of the thrower's arm. The Emperor Napoleon, who, as we all

* "Tribes of the Valley of the Amazon," by Clement Markham, Esquire.—Trans. Ethno. Soc., vol. 3.

† Smith's "Dictionary of Greek and Roman Antiquities."—Hasta.

know, has paid great attention to these weapons of the ancients, caused experiments to be conducted, under his own personal supervision, at Saint Germain, the result of which shewed that the range of a spear was increased from 20 to 80 meters by the use of this accessory.*

Transition from Club to Shield (Australia). (Plate XXI).

My next example of variation of form is taken from the Australian "hieleman," or shield. It may, on the first cursory consideration of the subject, appear fanciful to suppose that so simple a contrivance as the shield could require to have a history, or that the plain round target, for example, so common amongst many savage nations, could be the result of a long course of development. Surely, it may be said, the shells of tortoises or the thick hides of beasts would, from the first, have supplied so simple a contrivance. But the researches in palæo-ethology teach us that such was not the case; man came into the world naked and defenceless, and it was long before he acquired the art of defending himself in this manner. His first weapon, as I have already said, was a stone or a stick, and it is from one or other of these, that we must trace all subsequent improvements. The stick became a club, and it is to this alone that many of the earliest races trust for the defence of their persons. The Dinkas of East Central Africa have no shields, using the club, and a stick, fig. 170, hooked at both ends, to ward off lances.† The Shoua and the Bagirmi of Central Africa rarely carry shields, and they use a foreign name for it.‡ The Khonds, hill tribes of Central India, have never adopted the shield.§ The inhabitants of Tahiti use no shield;‖ the Sandwich Islanders use no shield or weapon of defence, employing the javelin to ward off lances: like the Australians, and, like the Bushmen, they are very expert in dodging the weapons of their enemies. In Samoa the club is used for warding off lances, and the warriors frequently exercise themselves in this practice. The kerri sticks of the Hottentots are used for warding off stones and assegais.¶

The club head formed by the divergent roots of a tree, fig. 155, offers great advantages in enabling the warrior to catch the arrows in their flight, and this led to the use of the jagged mace head form of club, which is here represented from many different localities. Fig. 155 is from Fiji, fig. 157 from Central Africa, fig. 156 from Australia, fig. 158 from New Guinea, and fig. 159 from the Friendly Isles. The curved clubs, of which a great variety are found in the hands of savages in every part of the world, are exceedingly well adapted to catch and throw off the enemy's arrow. The Australian malga or

* "Die Pfahlbauten des neuenborger sees," von E. Desor, p. 104.
† "Petherick," p. 391.
‡ "Barth," vol. iii, p. 451.
§ "Thirteen Years amongst the Wild Tribes, Khondistan," by John Campbell, C.B.
‖ Elis Polynesian Researches.
¶ "Kolben," p. 292.

"Lowel," as it is called by the Australians now in this country, and already described, is used in this manner.

By degrees, instead of using the club as a general weapon, offensive and defensive, especial forms would be used for defence, whilst others would be retained for offensive purposes; but the shield for some time would continue to be used merely as a parrying instrument. Such it is in Australia. In its most primitive form, it is merely a kind of stick with an aperture cut through it in the centre for the hand. The fore part varies with the shape of the stem out of which it was made; in some it is round, in others flat. This form appears to have branched off into two varieties; one developed laterally, and at last assumed the form of a pointed oval, as represented in figs. 165 to 168 and 169, these are frequently scored on the front with groves to catch the lance points. The other variety appears to have assumed a pointed form in front, so as to make the spear glance off to one side, as represented in figs. 160 to 164. The Australians are exceedingly skilful in parrying with these shields. One of the feats of the Australians now in this country, consists in parrying cricket balls thrown with full force by three persons at the same time. The hieleman is cut out of the solid tree and, like all their other weapons, invariably follows the grain of the wood.

In 1861, Mr. Oldfield, when engaged in collecting specimens of timber for the International Exhibition, came upon one of these shields, nearly finished and abandoned, but only requiring a few strokes to detach it from the growing tree, and he noticed the immense time and labour it must have cost the native to construct it, not less than 30 cubic feet of wood having been removed in digging it out of the tree with no better tool than a flint fixed to the end of a stick. Trees of sufficient size for these shields are not found in all parts of Australia, and in those places where they are wanting, the natives only obtain them by traffic with other tribes. The same cause may also account, in some measure, for the varieties of their form, yet, notwithstanding these numerous varieties, they never leave the normal type throughout the continent, and you might as well expect to see the Australians using a firelock of native manufacture, as to find in his hands the circular flat shield which is common in Africa, America, and ancient Europe.

Transition from Club to Shield (*Africa*). (Plate XXI).

In Africa, the development of the shield appears to have followed precisely the same course, commencing with the plain stick or club, fig. 170, and passing through the varieties represented in figs. 171, 172, and 173, which are scarcely distinguishable from the Australian hieleman, to the oval shield of the Kaffirs, fig. 174, and of the Upper Nile, figs. 175 and 176, which are of ox hide, but show their origin by a stick passing down the centre and grasped in the hand; with this stick they parry and turn off the lances of the assailant precisely in the same manner that the Australian employs the projecting point at the end of his oval shield. Judging by the side views represented in the Egyptian and Assyrian sculptures, similar shields were used by the ancients, and we

may especially notice the Assyrian shield, of small dimensions, fig. 178, mentioned by Mr. Rawlinson as being represented in the Assyrian sculptures, and having projecting spikes on the fore part, to catch and throw off the enemy's weapons.

Development of the Shield.

All these antique shields have one other feature in common with the shields of existing aborigines, viz., that they are held by a handle in the centre. It was only in a more advanced age when armies began to fall into serried ranks, that the broad shield was introduced and held upon the left arm, a mode of carrying it ill adapted to the requirements of the light-armed combatants. Besides the oval, the shield took other forms, but appears always to have been narrow in its earliest developments, fig. 176 from the Upper Nile closely resembles in outline fig. 177 from the New Hebrides. Livy describes the shields of the Gauls in the attack of Mount Olympus, B.C. 189, as being too narrow to defend them against the missiles of the Romans, and he also describes them as brandishing their shields in a peculiar manner practised in their original country.* This must without doubt have been connected with the operation of parrying. Sir Walter Scott describes the Scotch parrying with their shields. Shields in the form of a figure 8 are met with in various countries; Captain Grant describes the Unyamuezi as carrying a shield of this form.† Fig. 179 from this Institution is from Central Africa of a very primitive form. Fig. 180 is of the same shape from New Guinea, and the beautiful bronze shield, fig. 181,‡ of the late Celtic period in the British Museum found in the Thames, appears to be of an allied form. Fig. 182 is an ox-hide shield of the Bassutos, it is allied to that of the Kaffirs, Fig. 174, by having a stick at the back; and the peculiar wings with which it is furnished, connect it with that of the Fans of the Gaboon, on the West Coast, fig. 183, which latter is of elephant hide and has no stick at the back. No connection that I am aware of is known to have existed between these remote tribes which are of totally different races, but the forms of their shields here represented must, I think, have been derived from a common source.

Concluding Remarks.

It would be quite impossible within the space of a single lecture to produce more than a very small portion indeed of the evidence which is available in support of my arguments. If the principles which I have enunciated are sound, they must be applicable to the whole of the arts of mankind and to all time. If it can be proved that a single art, contrivance, custom, or institution, sprung into existence in violation of the law of continuity, and was not the offspring of some prior growth,

* Livy, Book xxxviii, chap. 16.
† "Walk across Africa," by Captain Grant.
‡ Horæ Ferales.

it will disprove my theory. If in the whole face of nature there is undoubted evidence of any especial fiat of creation having operated capriciously, or in any other manner than by gradual evolution and development, my principles are false.

It would be a violation of the law of continuity for example, if the principles which I am now advocating, in common with many others at the present time, opposed as they are to many preconceived notions, were suddenly to receive a general and wide-spread acceptance. This also, like other offsprings of the human mind, must be a work of development, and it will require time and the labours of many individuals to establish it as the truth, if truth it be.

Meanwhile it may be well that I should briefly sum up the several points which I have endeavoured to prove on the present occasion.

I have endeavoured to prove in the first place, though I must here repeat that I have produced only a very small portion of the evidence on the subject, that all the implements of the stone age are traceable by variation to a common form, and that form the earliest; that their improvement spread over a period so long as to witness the extinction of many wild breeds of animals; that it was so gradual as to require no effort of genius or of invention; and that it was identical in all parts of the world.

I have shown in the second place, that all the weapons of the Australians which I have described, are traceable by variation to the same common form, or to forms equally as primitive as those of the stone age of Europe: that it is perfectly consistent with the phenomena observed, that these variations may have resulted, or at least may have in a great measure been promoted by accidental causes, such as the grain of the wood influencing the shape of the weapon: that they were not invented or designed for especial purposes, but that their application to such purposes may have resulted from a selection of the implements already in hand; and that by this process, the natives of Australia, during countless ages, may have crept on, almost unconsciously, from the condition of brutes, to the condition of incipient culture in which they are now found.

I have compared these weapons of the Australians with others of the same form in various parts of the world, showing grounds for believing that whenever we shall be able to collect a sufficient variety of specimens to represent the continuous progression of each locality, the *modus operandi* will be found to have been everywhere the same.

Lastly I have alluded cursorily to the analogy which exists between the development of the arts and the development of species. It may be better to postpone any comprehensive generalization on this subject until a much larger mass of evidence has been collected and arranged. Sir Charles Lyell has devoted a chapter in his work on the antiquity of man to a comparison of the development of languages and the development of species. "We may compare," he says "the persistency "of languages or the tendency of each generation to adopt without "change the vocabulary of its predecessor to the force of inheritance "in the organic world, which causes the offspring to resemble its "parents. The inventive power which coins new words or modifies

"old ones, and adapts them to new wants and conditions as often as "they arise, answers to the variety-making-power in the animal crea- "tion." He also compares the selection of words and their incorporation into the language of a people, with the selection of species, resulting in both cases in the survival of the fittest.

Whilst, however, we dwell upon the analogy which exists between the phenomena of the organic world and the phenomena of human culture, we must not omit to notice the points of difference. The force of inheritance may resemble in its effects the principle of conservatism in the arts and culture of mankind, but they are totally dissimilar causes.

The variety-making-power may resemble the inventive power of man; nothing, however, can be more dissimilar, except as regards results.

When, therefore, we find that like results are produced through the instrumentality of totally dissimilar causes, we must attribute the analogy to some prior and more potent cause, influencing the whole alike.

It might be premature to speculate upon the course of reasoning which this class of study is likely to introduce; this much however, we may, I think, safely predict as the result of our investigation, that we shall meet with no encouragement to deify secondary causes.

Another subject to which we must necessarily be led by these investigations, although, as I before said, it does not fall actually within the scope of my paper, is the question of the unity or plurality of the human race.

The ethnologist and the anthropologist who has not studied the prehistoric archæology of his own country, compares the present condition of savages with that of the Europeans with whom they are brought in contact. He notices the vast disparity of intellect between them. He finds the savage incapable of education and of civilization, and evidently destined to fall away before the white man whenever the races meet, and he jumps at the conclusion that races so different in mental and physical characteristics, must have had a distinct origin, and be the offspring of separate creations. But the archæologist traces back the arts and institutions of his own people and country until he finds that they once existed in a condition as low or lower than that of existing savages, having the same arts, and using precisely the same implements and weapons; and he arrives at the conclusion that the difference observable between existing races is one of divergence, and not of origin; that owing to causes worthy of being carefully studied and investigated, one race has improved, while another has progressed slowly or remained stationary.

In this conclusion he is borne out by all analogy of nature, in which he finds frequent evidences of difference produced by variation, but no one solitary example of independent creation. Are not all the branches of a young tree parts of the same organism, and yet one will be seen to throw up its shoots with a vigorous and rapid growth, whilst another turns towards the ground and ultimately decays? Not to mention the variations produced by the breeding of animals, with

which we are all more or less familiar; we see under our families of men diverging in this manner. One branch, causes familiar to us in every-day life, will become highly whilst another continues to live on in a low condition that in the course of a few years the disparity, mental an between these two branches, bearing the same name, will in proportion to the time of separation than that which in th countless ages, has separated the black from the white man.

At the present time there is a tendency to rectify these in whether in regard to our own or to other races, and there c doubt that in the course of time, all that remains of the var of mankind will be brought under the influence of one c But as this progressive movement is often led by men who made the races of mankind their study, they are perpetu into the error of supposing, that the work of countless age gence, is to be put to rights by Act of Parliament, and by applying to the inferior races of mankind, laws and insti which they are about as much fitted as the animals in the Gardens.

In conclusion, I have only a few words to say upon the def ethnographical collections generally. It will be seen that i exhibit the continuity and progression of form, I have be to collect and put together examples from many different and, as it is, it will have been noticed that many links of con evidently wanting. This is owing, in a great measure, to the period during which the arts and customs of primeval races made the subject of scientific investigation; but it also arise absence of system on the part of travellers and collectors wh times appear to have had but little knowledge of the evid these specimens of the industry of the aborigines is destined and who have, therefore, neglected to bring home from t regions they visited all the varieties of the several classes ments which each country is capable of affording, thinkin good example of a tool or weapon might be taken as a sampl rest.

I am not so presumptuous as to suppose that the par rangement which I have adopted, may not require frequ cation as our evidence accumulates, but I trust that I sh have made it apparent to those who have followed the co argument, that without the connecting links which unite with another, an ethnographical collection can be regarded i light than a mere toy-shop of curiosities, and is totally u science.

Owing to the wide distribution of our Army and Navy, th of which professions are dispersed over every quarter of and have ample leisure for the pursuit of these interesting s Institution possesses facilities for forming a really systemati of savage weapons, not perhaps within the power of any c tution in the world. The time is fast approaching when th pre-historic evidence will no longer be forthcoming. The coll

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·eady what, for this country, must be regarded as a good one, and may venture to hope that the remarks I have now the honour of ıng will be of service in collecting the materials for the improve- t of it, I trust it may be thought, that my labours and your patience not have been thrown away.

LECTURE.

Friday, June 26th, 1868.

Lieutenant-General HENRY EYRE, in the Chair.

THE BATTLE OF KÖNIGGRÄTZ.

By Colonel Walker, C.B., Military Attaché, Berlin.

It has occurred to me that in connection with the purchase of a model* of the great battle ground of the 3rd July, 1866, a relation of the events preceding and belonging to that eventful day may not be unacceptable to the members of the Royal United Service Institution. My description must to a certain extent be from a Prussian point of view; but I am sure that my hearers will fully agree with me in feeling that all unavoidable criticism should be forborne, and I purpose therefore to confine myself to such a relation of these events, based on reliable sources from both sides, and on personal observation, as may avail to present to them a fairly clear view of this combat of giants. The task of criticism may well be left to others, more capable of forming and more justified in expressing their opinions on such matters.

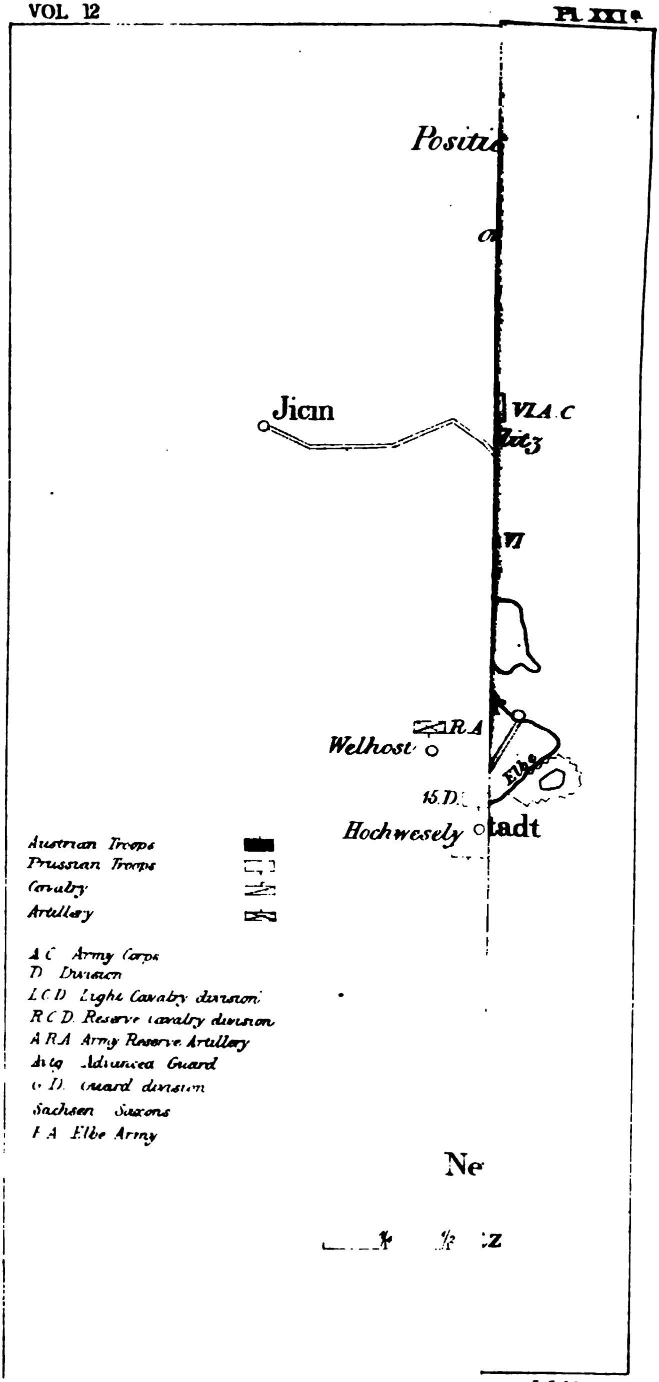
On the 2nd July, the Prussian forces consisting of the Elbe Army (three divisions, under General Herwarth), the first army (three corps under Prince Frederick Charles), and the second army (four corps, under the Crown Prince), were extended over a line stretching from Smidar to Gradlitz on the Elbe, in the positions which I first propose to detail, while the Austrians and Saxons lay in a position which they had taken up on the 1st July, behind the Bistritz and Trotina.

The Elbe Army consisting of the 14th, 15th, and 16th divisions, occupied the line of Chotelitz, Hoch Wesely, and Lhota, with its advanced guard at Smidar, and its reserve artillery at Welhost.

The first Army, consisting of the second, third, and fourth corps, and the reserve cavalry corps under Prince Albrecht of Prussia, bivouacked in the district marked by the villages or small towns, Aujezd-Sylvara, Wostromer, Gutwasser, Horitz, Dobes and Miletin, with advanced guards at Milowitz and Gross Jeritz.

The second Army lay with the first corps at Ober Praussnitz, the Guard at Königinhof and Neu Rettendorf, and the fifth and sixth corps at Gradlitz.

* The maps are, the one a reproduction of the sketch map published with the Prussian official account of the campaign, the other the ground plan of the model of which the lecture is an explanation.—B. W.


Positi
Jicin
VI.A.C
VI
R.A
Welhost
Elbe
15.D.
Hochwesely
tadt
Austrian Troops
Prussian Troops
Cavalry
Artillery
A.C. Army Corps
D. Division
L.C.D. Light Cavalry division
R.C.D. Reserve cavalry division
A.R.A. Army Reserve Artillery
Av.G. Advanced Guard
G.D. Guard division
Sachsen Saxons
E.A. Elbe Army
Ne
½

J. Jobbins

which I proposed to take full indemnification for our bivouac at Eypel,

VOL. 12

Pl. XXI^b

The head-quarters of Prince Frederick Charles were at Kamenetz; those of General v. Herwarth, who stood under the immediate orders of the Prince, at Hoch Weseley; while the Crown Prince was at Königinhof.

His Majesty the King left Berlin on the 30th June, for the purpose of taking command of his combined armies in Bohemia; heard while passing through Reichenberg, of the great success achieved by the first Army at Gitschin; reached Sichrow on the 1st July, and on the 2nd established his head-quarters at Gitschin. But little was known of the actual disposition of the Austrian forces. The movements taking place were not supposed to include more than three or four corps; and it was generally supposed that the Austrian North Army would be found behind the Elbe, with its flanks covered by Josephstadt on the right, and by Königgrätz and the river Adler on the left, while the movements of troops on the plateau of Dubenetz were intended to cover this concentration.

Two lines of operation therefore suggested themselves; either the enemy must be attacked in his position, or out-manœuvred into relinquishing it. From all that I have heard since on the subject, it appears manifest that the latter was in course of adoption, that it was intended to execute a flank march towards Pardubitz, and to compel the Austrian Army to cede its advantageous position by threatening its communications with Olmütz and the capital. In either case great difficulties presented themselves, and it was therefore determined that the following day should be devoted to partial rest after the fatiguing marches and almost incessant fighting of the preceding week, and to reconnoitring the position of the enemy. For this purpose General v Herwarth was directed to move towards Chlumetz, so as to keep an eye on Prague, and secure the passages of the Elbe, near Pardubitz: the first Army was to move by a right incline into the line of Horitz-Neu Bidzow, reconnoitring with a part of the left wing towards Sadowa: the first corps had orders to push forward through Miletin towards Bürglitz and Cerekwitz, so as to cover the subsequent flank march of the second Army, and keep up the connection between the two Armies: and the remaining corps of the second Army were to remain in their bivouacs on the left bank of the Elbe, under the protection of strong reconnoitring parties in the direction of the small rivers Aupa and Mettau.

Should it be ascertained either that the supposed position proved too strong for attack, or that the Army had been already withdrawn, the general movement towards Pardubitz was to be carried out.

Such were the impressions under which the wet and cheerless evening of the 2nd July closed on the actors in the great drama of the succeeding day. At the head-quarters of the second Army, a day of partial rest was fully expected, and it was proposed at dinner that certain members of the staff should ride out after breakfast, and take part in the projected reconnaissance towards the Aupa and Mettau. As for myself I was billeted on the Roman Catholic rector of Königinhof, where I had a comfortable room, and a bed with clean sheets, in which I proposed to take full indemnification for our bivouac at Eypel,

on the 28th, and for three nights of unrest on a knotty and broken-down sofa, at Praussnitz.

It was at the head-quarters of Prince Frederick Charles that the first reliable news of the hostile force was obtained. The Prince, who had been to Gitschin to wait upon the King, learnt soon after his return, that a detachment of the 27th Regiment, at Cerekwitz, the most advanced outpost of General v. Fransecky's (the 7th) division, reported the existence of an Austrian camp at Lipa; while two cavalry patrols,—one conducted by an Officer of the staff, the other by an Officer of the 10th Hussars, had lit on strong parties of Austrian cavalry, the one near Dub, the other near Benatek, from which they had only saved themselves by hard riding,—had ascertained that the heights near Dub were occupied by an Austrian brigade; that the third Army corps was near Sadowa; that the first and tenth were somewhere in the neighbourhood; and that a strong force of cavalry, with a numerous artillery, was near Lipa, and the Saxons at Problus. These reports reached Kamenetz between six and seven o'clock in the evening of the 2nd July.

It is now known, that, in the night between the 30th June and the 1st July, the whole Austrian Army, with the exception of the first corps and of the Saxons who had been opposed to the advance of the first Prussian Army, had withdrawn from their position on the plateau south-east of Königinhof to another not far removed from that in which it accepted battle two days later.

The first column, composed of the third and tenth corps, with two divisions of cavalry, moved from Gross Bürglitz and Liebthal to Lipa, one division of cavalry occupying a bivouac between Dohalitz and Dohalicka; the sixth corps and a division of cavalry moved through Dubenetz and Horinowes, taking post at Wsestar; the fourth and eighth corps by Litic and Nesnasow to Nedelist; and the second corps, with the remainder of the cavalry, by the right bank of the Elbe, through Dölzen to Trotina. These movements were only completed on the evening of the first July, by which time the first Austrian corps had reached its ground between Wsestar and the fortress, while the Saxons stood between Lubno and New Prim.

As I shall presently return to a detail of the positions they subsequently took up, I will now proceed to sketch the results of the above mentioned reports to the head-quarters of the first Prussian Army at Kamenetz. It was known that the second Army had been engaged with four different Austrian corps during the operations of the previous week, while the concentration of troops near Sadowa led to the conclusion that an attack on the Prussian right was contemplated. After due consideration of this probability, Prince Frederick Charles issued the following orders to the first and Elbe armies, and wrote in explanation of his intentions to the Crown Prince. These measures were completed at about 9 P.M., when his Royal Highness despatched General v. Voigts Rhetz, the chief of his staff, to Gitschin, for the purpose of making a full report to the King, and of obtaining his Majesty's sanction to the projected operations.

The dispositions made for the advance of the first Army will be

gathered from the subjoined translation of the orders issued on the occasion:—

"The first Army will be formed in order of battle at daybreak to-"morrow in front of the position on the Bistritz, near Sadowa, on the "Horitz Königgrätz high road.

"1. The division Horn* will stand at 2 A.M. at Milowitz.

"2. The division Fransecky† proceeds past Gross Jeritz and Cerek-"witz, and will stand at 2 A.M. in the position at the chateau of the "last named place.

"3. The divisions Manstein and Tümpling,‡ under command of "Lieutenant-General v. Manstein, move at 1.30 A.M. into a reserve "position south of Horitz, the division Manstein to the east, the "division Tümpling to the west of the Horitz Königgrätz high "road. It is expected that both divisions will be in their places at "3 A.M.

"4. The second Army corps moves with one division to Psanek, "the other to Bristan. Both divisions will be at their posts by "2 A.M.

"5. The cavalry corps will saddle at daybreak, and remain in its "bivouacs till further orders.

"6. The reserve artillery of the Army will move to Horitz; the "reserve artillery of the third corps *à cheval* of the high road Horitz-"Miletin; the reserve artillery of the fourth corps *à cheval* of the "Horitz-Gitschin-Libonitz high road.

"7. The General of Infantry v. Herwarth 1st will move with all "his available force against Nechanitz, so as to arrive there as early "as possible.

"8. His Royal Highness the Crown Prince has been requested to "make a demonstration against Josephstadt with one or two corps, "and to march another corps on Gross Bürglitz.

"9. The troops on the left wing must themselves provide for "taking up the communication with the second Army; those on "the right with the troops of General v. Herwarth, as early as "possible.

"10. The trains move with daybreak into the following positions, "there to be parked close to the high roads:—

"Of the fifth division to Masowitz east of that place; of the sixth "division through Belohrad to the left bank of the brook Jaworka; of "the seventh division through Domoslawitz to Suirkowitz, west of "that place.

"The second corps, that of the third division, through Wostromer "to a point between Wojitz and the high road Horitz-Gitschin; of "the fourth division, through Aujezd Sylvara to Sobsitz, west of that "place.

"Of the cavalry corps to Chomutitz.

"Of the reserve artillery of the third corps to Chotec, east of that

* 8th of 4th Corps.
† 7th of 4th Corps.
‡ 3rd Corps.

"place; of the fourth corps, through Wostromer to the right bank of "the brook Jaworka.

"11. I shall be found at Milowitz after daybreak.

"(Signed) The General of Cavalry,
"FREDERICK CHARLES."

At 9.30 P.M. the following letter was forwarded to the Crown Prince:—

"His Majesty the King has informed me of the reconnaissance "towards the Aupa and Mettau to be executed to-morrow (3rd July) "by your Royal Highness. As, however, a reconnaissance under-"taken from hence, and the reports of the outposts to-day have shown "that a very considerable hostile force is concentrated near Sadowa "and Lipa, on the high road from Horitz to Königsgrätz, the advanced "guard of which has been pushed forward to Dub, I intend to attack "the enemy to-morrow, the 3rd July, and in accordance with the "object entrusted to me to throw him back towards the Elbe.

"But as strong detachments of the enemy have moved from "Josephstadt towards the right bank of the Elbe, I can only suppose "that they are intended to operate against my left flank in the event "of my advance on Königgrätz. A diversion of this nature would "compel me to divide my force, and would impede the attainment of "my desired end—the destruction of the enemy.

"I, therefore, request your Royal Highness to move to-morrow, "3rd July, with the guard, or more corps, from Königinhof in the "direction of Josephstadt, on the right bank of the Elbe, as a security "to my left flank. I am the more induced to express this wish that, "on account of distance, I cannot, on my part, expect the early arrival "of the corps of Bonin,* and because, on the other hand, I presume "that in the reconnaissance ordered for to-morrow, your Royal High-"ness will not meet with any very considerable hostile force.

"I beg to add that my left wing will stand at Gross Jeritz and "Cerekwitz.

"(Signed) FREDERICK CHARLES,
"Prince of Prussia."

The order to General v. Herwarth was as follows:—

"The first Army will be formed early to-morrow, at break of day, "for the attack of the position on the Bistritz near Sadowa on the "Horitz-Königgrätz high road. General v. Herwarth will move "with all the troops available to Nechanitz, so as to arrive there as "early as possible. I shall, in the first instance, be found at Milo-"witz."

This order reached General v. Herwarth at half-past 12, midnight; and orders were at once issued to the Elbe Army to march at 3 A.M., the advanced guard commanded by Major-General v. Schoëler, on Nechanitz; Canstein's division† to Neu Bidzow until relieved by the Landwehr division of Lieutenant-General v. Rosenberg, then on

* The 1st.
† 15th of 8th Corps.

Nechanitz; the division Münster* was ordered to cross the Jaworka at Smidar, and march to Lodin, from whence circumstances would decide whether a movement in the direction of Mzan, or through Sucha towards Nechanitz, was most to be desired; the division Etzel† through Smidar, and to follow the advanced guard; as also the reserve artillery, which was, if possible, to branch into the line of march on Nechanitz, if not, to continue its march in the same direction as that of the sixteenth division.

Immediately after the issue of these orders, the chief of the staff started for Gitschin, where he arrived, but just too late to meet Major-General v. Blumenthal, the chief of the staff of the second Army, who had not long left the head-quarters of the King on his return to Königinhof.

His Majesty the King, on learning the fresh news brought by General Voigts Rhetz, at once formed the determination to attack the Austrian Army with his whole force; the dispositions of Prince Frederick Charles were confirmed; and the following memorandum was dispatched by General von Moltke to the head-quarters of the Crown Prince:—

"According to reports received at the head-quarters of the first "Army, the enemy, in the strength of three *corps d'armée*, which will, "however, probably be reinforced, has advanced to a position on the "Bistritz near Sadowa, and it may be expected that an engagement "with the first Army will there take place. Your Royal Highness "will at once make the necessary arrangements to operate with all "the force at your disposal in support of the first Army against the "right flank of the supposed advance of the enemy, and attack as "early as possible.

"The dispositions made this afternoon under other circumstances "are hereby cancelled.

"Gitschin, 11 P.M., 2nd July.

"(Signed) VON MOLTKE."

This order left Gitschin at 12 midnight. It has been erroneously stated that this important order, on which, indeed, as subsequent events proved, the fate of the campaign depended, was entrusted to but one person for delivery. This statement is incorrect. One copy was forwarded through Kamenetz to Königinhof; a second was carried by Lieutenant-Colonel Count Finckenstein, Aide-de-camp to the King, by another route which led past the outposts of the first Army corps, to whose commander a further order was forwarded by the same Officer, informing General v. Bonin of the expected operations, and desiring him at once to hold the corps under his command prepared for immediate movement on receipt of definite orders from his own Commander-in-Chief, on the receipt of which he was to attack independently, according to circumstances. Count Finckenstein reached Königinhof at about half-past three or four o'clock; found General v. Blumenthal just getting into bed, after his fatiguing drive of nearly

* 14th of 7th Corps.
† 16th of 8th Corps.

sixty English miles to Gitschin and back again, and his subsequent reports to the Crown Prince, and despatch of orders to the left wing, in accordance with the previously received request of Prince Frederick Charles.

The Crown Prince was at once called, maps were brought out, staff Officers were roused from their quarters, and at 5 A.M. the necessary orders for an advance of the whole second Army were dispatched to the various corps composing it.

The orders were as follows:—

"From information received here, a hostile attack is expected to "take place to-day on the first Army, posted at Horitz, Milowitz, and "Cerekwitz, and the second Army will move to its support in the fol- "lowing manner:—

"1. The first Army corps will march in two columns over Zabres "and Gross Trotin to Gross Bürglitz.

"2. The cavalry division will follow the first corps to that point.

"3. The corps of the guard will move from Königinhof on Jericek "and Lhota.

"4. The sixth corps to Welchow, from whence it must detach for "the observation of Josephstadt. The reconnaissance ordered for "to-day will not take place.

"5. The fifth corps will follow two hours after the departure of the "sixth corps, and will march on Chotieborek.

"The troops will march as early as they possibly can do so, and "leave trains and baggage behind, which will only come up by special "orders from the head-quarters of the Army.

"Head-quarters, Königinhof, 3rd July, 5 A.M.

"By command,
"The Chief of the Staff,
"(Signed) BLUMENTHAL,
"Major-General."

Having now detailed the positions of the Prussian Armies up to the evening of the 2nd July, and the order of march during that night and the following morning, I proceed to describe those taken up by the Austrians and Saxons, and I avail myself for this purpose of the most authentic documents published in Vienna since the conclusion of the campaign. Before doing so, however, I must endeavour to give some idea of the ground on which the battle was fought.

At the distance of a German mile* and a half from the fortress of Königgrätz, the great highroad to Horitz and Gitschin crosses a small stream, the Bistritz, at the village of Sadowa. The direction of the road is as nearly as possible north-west, that of the stream nearly north and south. The Bistritz covers the front of the position; the highroad, as will be seen later, gave the intended line of retreat in case of disaster.

North of Königgrätz, and at about the same distance, flows another small brook, the Trotina, which, after being joined by the Trotinka at

* A German mile is 4⅗ English, or 10,000 German paces.

the village of Racitz, takes a south-easterly course between high banks, and falls into the Elbe at the village of Lochenitz. Due west of Königgrätz, at a distance of rather more than a German mile and a half,* is the small town of Nechanitz, with a bridge over the Bistritz.

Taking Königgrätz as the centre, the arc of a circle drawn on the radius Königgrätz Sadowa will fall a little beyond Racitz, and a little short of Nechanitz, while the chord of this arc will intersect the most important features of the Austrian position. Both streams run for the greater part of their course through marshy ground, there are but few fords, and the Bistritz can only be crossed by cavalry or artillery over bridges at the small villages, the principal of which are those at Sadowa and Nechanitz.

Combined with the not unimportant heights bordering and in some places overhanging their valleys, both streams give prominent cover to the whole front and right flank of the ground taken up by the Austrian and Saxon Armies. At one point only was this protection wanting. Between Benatek and Racitz, the two streams are separated by about half a German mile of *firmer ground*, and it will be seen hereafter in how far this circumstance conduced to the overthrow of the Austrian Army. The interior of the position was admirably adapted for defence. Elevated generally 150, in some parts nearly 300 feet† above the river level, the heights within its rayon gave a marked command over all the approaches. Villages and woods are found as if placed for defence, while the easy slopes in the rear facilitated the movements of troops during the varying fortunes of the day, and afforded free communication between the Army and its reserves, the gradual fall of the slopes from west to east giving great facilities for covering their place of assembly. The whole distance embraced by the front was about 20,000 paces, or two German miles,‡ but as the actual position was somewhat in rear of this front, which was only occupied by outposts and detachments, the strength of the combined Armies tactically fulfilled the requirements of the position.

The Königgrätz Horitz highroad rises gradually from the inundations of the fortress to a point between Briza and Sweti, where two country roads fork, that on the right hand passing through Nedelist and Sendrasitz to Racitz, the left-hand road passing over a considerable elevation on which the villages of Prim and Problus are situated, to Nechanitz.

About a couple of English miles short of Sadowa, the road passes to the left of, and about a thousand paces distant from, the height of Chlum, after which it again falls to the level of the Bistritz at Sadowa, passing, however, at Lipa over an extended ridge, which, dominating within 3,000 paces the bridges at Sadowa and Dohalitz, may perhaps be considered as not only the centre, but the key to the position.

About half way between Lipa and Sadowa the road runs to the right of the wood of Sadowa, sometimes called the wood of Dohalitz.

* 7 English miles.
† Prussian foot as 102·97 to 100 English.
‡ 9 English miles.

Further to the north is the lateral valley in which lies the village of Cistowes, and directly north of this point rises a height covered with the great wood of Maslowed, the highest point of which is nearly 300 feet above the level of the Bistritz, to the right of which the neighbouring height of Horinowes, marked by two lime trees destined to live in the history of this great battle, forms the salient angle of the position, and is thrust out like a bastion into the plain, exactly where, in the interval between the Bistritz and Trotina, the protection afforded by the two streams is wanting.

It will be remembered that during the previous days the allied forces had been concentrated between the Trotina and Bistritz in a narrow position which afforded but limited shelter for so large an Army, in front of the fortress of Königgrätz, and of the river Elbe, while Field Marshal von Benedek had established his head-quarters in the Prague suburb. While the Prussian Armies were extended over a front of more than twenty English miles that of the Allies scarcely exceeded five, and it was out of this crowded situation that the following order, issued on the evening of the 2nd July, set on foot the movements which arrayed the eight corps, and five divisions of cavalry, of which the Allied Armies were composed, in a line extending from Nechanitz to the village of Trotina.

"Königgrätz, Prague Suburb, 2nd July, 1866.

"Intelligence arrived this day shows that large masses of the "enemy's troops are in the neighbourhood of Neu Bidzow, Smidar, and "in the direction of Horic;* partial engagements have already taken "place between the outposts at Kobelitz and Sucha. From the "position of the enemy it may be assumed that an attack will be made "to-morrow, which in the first instance will be directed against the "Saxon Army corps. In this event I order as follows:

"The Royal Saxon corps will occupy the ridge of Popowitz and "Tresowitz, the left wing slightly refused, and covered by its own "cavalry. In front of this position only advanced detachments are to "be thrown out; to the left and somewhat to the rear on the extreme "left flank by Problus and Prim the first light cavalry division will "take post on suitable ground. The 10th corps takes post on the "right of the Saxon corps, and lastly to the right of the 10th the 3rd, "which will occupy the heights of Lipa and Chlum. The 8th corps "will serve as immediate support to the Saxon corps, and will be posted "in rear of it. Troops not herein named will only be held in readiness "so long as the attack is confined to the left wing, but should the "hostile attack assume larger dimensions, and also be directed against "our centre and right wing, the whole Army will take up a position "for battle, and the following will be the dispositions:

"The 4th corps will move up on the right of the 3rd corps to the "heights of Chlum and Nedelist, and on the extreme right flank, next "to the 4th, the 2nd corps. The 2nd light cavalry division will move "to the rear of Nedelist, and remain there in readiness. The 6th

* Horitz, as written by the Prussians.

"corps will assemble on the heights of Wsestar, the 1st corps will "move to Rosnitz, both corps in close formation. The 1st and 3rd "reserve cavalry divisions move to Sweti, the 2nd reserve cavalry "division to Briza.

"Under the second supposition, of a general attack, the 1st and 6th "corps, the five cavalry divisions, finally the reserve artillery of the "Army,* which will take post behind the 1st and 6th corps, form the "reserve of the Army at my sole disposal.

"Early to-morrow the whole Army must be in battle order; the "corps first attacked must at once communicate with the nearest "corps, which will further the transmission of the intelligence "received.

"The 8th Army corps will move at once from its present camp; an "Officer must be sent forward to the Saxon head-quarters, who, ac- "cording to circumstances, that is whether the action has already "commenced or is only imminent, will return to meet the 8th corps, "and conduct it into the ground selected for it in rear of the Saxons. "Should there be no prospect of a hostile attack, the 8th Corps will "occupy the camping ground already pointed out near Charbusitz.

"Should only the left wing of the Army be attacked, I shall be "found with it, in the event of a general action on the heights of "Chlum. Should the Army be compelled to retreat this will take place "on the high road from Holic to Hohenmauth, without disturbing the "fortress.

"Immediately on the receipt of this order, the second and fourth "corps will throw pontoon bridges over the Elbe, namely, the second "corps two bridges between Lochenitz and Predmeritz, the fourth corps "also two bridges at Placka.

"Any extra material required will be furnished by the train of the "sixth Battalion. Should the repair of the approaches to the bridge "sites be found necessary, it will be effected in like manner.

"The first corps will at once cause the engineers of the corps to "throw a bridge over the Adler at Swinar. The execution of these "orders is at once to be reported, verbally or in writing, through "Officers, and the places selected for the bridges must be carefully "designated.

"The dispositions for a possible retreat will be made known to- "morrow.

"(Signed) BENEDEK."

It appears very doubtful whether the last paragraph was ever carried into effect; at least, it has been strenuously denied by more than one of the Austrian Corps Commanders.

In pursuance of these orders, though, to some extent, and indeed in one instance fatally so, not in strict conformity to them, the early morning of the 3rd found the whole Austrian Army in movement towards the high ground east of the Bistritz.

On the extreme left, the Saxon corps occupied the ridge overlooking

* 128 guns.

the Bistritz at the villages of Lubno, Popowitz, and Tresowitz, with one brigade of the division of General Schimpff; while the other took post in Problus and Nieder Prim. Nechanitz was held by a detachment of no great strength, the cavalry division taking up ground to the east of Nechanitz, so as to cover the withdrawal of the outposts. The division of General v. Stieglitz, with the reserve artillery, held the position between Problus and Nieder Prim.

The Crown Prince of Saxony, who appears to have shown eminently soldier-like qualities, and who was, moreover, fortunate in the able assistance afforded by the appointment of Lieutenant-General von Fabrice as chief of his staff, had requested permission to occupy Nechanitz and Hradek in force, but had been refused.

The eighth Austrian corps, having left two battalions in Horenowes, and further weakened by the absence of the brigade Rothkirch, was on the march towards the position allotted to it in support of the Saxons, as was also the first light cavalry division, under Major-General Baron Edelsheim, when the first cannon shots were heard. The tenth corps, sadly reduced by its losses at Trautenau and Soor-Burgersdorf, on the 27th and 28th June, and numbering not more than 18,000 combatants, occupied the sugar manufactory on the right bank of the Bistritz, Unter-Dohalitz, Dohalicka, Mokrowous, and part of the wood of Sadowa, while one brigade held the village of Chlum, until the arrival of the third corps, to which the defence of Chlum, Lipa, and the remainder of the wood of Sadowa had been allotted. So far the plans of the Commander-in-Chief appear to have been carried out; but further to the right, the troops were disposed in a manner to which I beg careful attention, for here it was at a later period of the day that the fate of the battle was decided.

It will be remembered that the fourth corps had been ordered to the ridge between Chlum and Nedelist; the second to extend the line to the right of the fourth; and the second light cavalry division to take post in rear of Nedelist, and it was on this line, as I shall show presently, that the most important fieldworks had been thrown up on the previous day. Instead of carrying out this order, both corps deployed their forces on the line Cistowes, Maslowed, Horinowics. The Brigade Henriquez,* with a regiment of cavalry was left in position near the village of Trotina, and two battalions of infantry held the village of Racitz in advance of the right flank. The reserve corps took post as directed by the orders of the previous evening, the reserve artillery being placed on the heights between Wsestar and Sweti, the two infantry corps near Rosberitz.

The actual length of the Austrian front was about a German mile and a half (seven English miles), including Edelsheim's cavalry and the brigade Henriquez, nearly two German miles, while half a German mile in rear of the centre two complete corps, and four divisions of cavalry, with a reserve artillery force of 128 guns, were assembled on ground from whence free access was afforded to every part of the line.

The works of defence thrown up had been planned on the 1st, and

* 2nd Corps.

executed under the superintendence of Colonel von Pidoll, of the Imperial Engineers, on the 2nd July. They principally consisted of five batteries.

No. 1 was 1,400 paces north of the Church of Nedelist, at the junction of five roads; No. 2, 1,500 paces north-west of the same point, on the declivity below Maslowed; No. 3, 1,000 paces east of the northern end of Chlum, measured from the *debouche* of the main road through the village; No. 4, to the west of this spot; and No. 5, 500 paces from the western outlet of that village. Abatis were also constructed in the wood of Lipa, not far from battery No. 4; there were two more batteries, which we will call 6 and 7, for the protection of the southern skirts of the same point; and rifle trenches were dug in front of No. 3, and on the flanks of Nos. 1, 4, and 5. Indeed the wood of Lipa may be said to have been thoroughly protected, and the protracted resistance encountered here by the first Prussian Army fully justified the prudence of these measures.

The heights of Horinowes, and the line of the Trotina were left entirely without artificial defence, and the efficacy of the more important batteries above-mentioned was completely neutralized by subsequent events.

Very little was done on the left wing. The only work of importance was a battery for twelve guns, which the Saxon Commander-in-Chief had caused to be thrown up at Hradek, overlooking the village of Lubno. So much time had been expended in the defences of Chlum and Lipa, which in addition to the more complete works above mentioned, had been strengthened by the usual measures adopted for the defence of villages, that the works round Problus were only commenced after the beginning of the action, and were confined to placing that village and Nieder Prim in a state of hasty defence, and in the construction of an abatis on the western flank of the wood between Problus and Charbusitz. Strange to say neither of the bridges at Nechanitz or Sadowa were blown up.

On the previous day a council of war had been held at the Austrian head-quarters, attended by the commanders of corps, and the chiefs of their respective staffs, who had assured the Field Marshal of the good spirit reigning in the Army, and of the readiness of all ranks to accept battle. Some changes had taken place among the superior officers since the commencement of the campaign. The Archduke Leopold had ceased to command the eighth corps since the 29th June; on the morning of the 3rd July, Count Clam Gallas, summoned by Imperial command to Vienna, resigned the command of the first corps; while the still more important posts of chief of the staff, and of the council of operations, held respectively by Baron Henickstein and Major-General von Krismanic, were vacated at the very moment of action, by the summary removal of the above-mentioned officers. The forces arrayed against each other on the day which was to decide the question of supremacy in Germany, may I think fairly be reckoned as follows:—

Austrian North Army, seven corps, and five divisions of cavalry, 184,000, and the Saxons 22,000 men, in all 206,000 men, with 700 guns, exclusive of train, but including the artillery.

The Prussian returns give the following numbers, which may be assumed to be correct:—

First Army, three corps, combatants of all ranks ..	84,830
Elbe Army, three divisions	39,088
Second Army, four corps	97,066
	220,984

with 780 guns.

To these may be added the reserve division of Landwehr of the guard, amounting to 9,200 men, which however, notwithstanding all exertions, only reached Nechanitz late on the evening of the day of battle, having marched since morning from Kopidlno.

In the first line stood the Saxons, tenth, third, fourth, and three brigades of the second Austrian corps, which may be reckoned as 117,500 men; in support three brigades of the eighth corps, Edelsheim's cavalry division, and the brigade Henriquez, 25,000 men; and in reserve the first and sixth corps, the second light and three reserve cavalry divisions, and the reserve artillery, 63,500 men.

I have already mentioned that it rained heavily on the evening of the 2nd, and during the greater part of the early morning of the 3rd of July. It rained heavily all that morning, till about 11 o'clock; the day remaining dark and gloomy till between 3 and 4, when it cleared up completely. So much rain had fallen as to add greatly, not only to the discomfort of the troops, but also to the difficulties of the march. A great part of the country was covered with standing corn of a luxuriant growth, which not only impeded the movements of the infantry, but, clustering round the fetlocks of the horses, and the spokes of the gun-wheels, rendered the advance of the cavalry and artillery one of the most difficult on record.

At an early hour of the morning, the whole of the first Prussian Army had taken up the positions allotted to the several corps and divisions. Prince Frederick Charles left Kamenetz soon after one o'clock for Milowitz, where shortly before six, an orderly Officer of General von Herwarth reported to him that the three divisions of the Elbe Army would reach Nechanitz successively in the interval between 7 and 9 o'clock. News from the Crown Prince could not be so soon expected, the more so that the orders for his advance had proceeded directly from the King, to whom, naturally, his acknowledgment of them would first be delivered. The Prince was, however, fully entitled to reckon on the assistance of the first corps, under General von Bonin, whose head-quarters were at Oper Praussnitz on the right bank of the Elbe, and the co-operation of the remainder of the second Army could, with certainty, be reckoned on at a later period. He was clearly of opinion that the circumstances justified an early attack by the first Army, so as to engage and hold fast the allies, to waste their strength, and ensure their annihilation.

At 6 A.M. he ordered a forward movement, which was carried out as follows:—

The eighth division advanced on and to the left of the high road

against Sadowa; the second corps to its right, against the villages below that point; while the seventh division received orders to debouch from Cerekwitz so soon as the troops directed against Sadowa had come into action. The fifth and sixth divisions followed the eighth in reserve; the reserve artillery was ordered to move by the great high road, and the cavalry corps, which had been advanced from Gutwasser to Petrowitz, was ordered to follow the right wing and secure the connection with the Elbe Army.

It was about 7 a.m., that the Austrian batteries, between Sadowa and Maslowed, first opened on the heads of the Prussian columns, though the advanced guard of the eighth division was already engaged in a sharp fire of musketry with the troops occupying the brick yard at Sadowa, while further to the right, partial affairs with the outposts, and the occasional fire of field guns, had for more than half an hour marked the commencement of the action.

The advanced guard of the Elbe Army reached Kobilitz at half-past 6, and found Alt Nechanitz occupied by a battalion of Saxon infantry, which retired on its supports after having set fire to the bridge over a millstream, and the neighbouring farm buildings. The troops at once pushed on to the attack of Nechanitz, while flank detachments sought passages through the marshy meadows, which made the Bistritz unpassable, both above and below the little town. The cavalry corps reached Petrowitz at the same hour, and by 8 o'clock was in an advantageous position at Sucha, between the Elbe and first armies, and fronting the Bistritz. Werder's division of the second corps reached the neighbourhood of Sawadilka soon after eight; Herwarth's division of the same corps, followed by the reserve artillery, marched across country towards Mzan, near which village the division formed for attack. The villages on the opposite side of the stream were fully occupied by the enemy, and 32 guns above Dohalicka opened heavily on the advancing columns.

Fransecky's division* reached Cerekwitz as early as 3 A.M. Its able commander at once took steps to notify the position of his troops to the outposts of the first division of the guard, which extended to Daubrowitz, and prepared to march as soon as the first shots in Sadowa should give him the signal for his advance.

No great resistance was made by the Austrian outposts; the position lay behind, and not on the Bistritz, the passage of which could only be effected at well-known points, which were amply covered by the artillery posted on the terraces of the southern bank, and by the possession of the woods of Sadowa, Lipa, and Maslowed, and the villages in their rear.

At 8 o'clock loud hurrahs from the Prussian reserves announced the arrival of the King, who at once proceeded to acquaint himself with the position of affairs, and, after consultation with Prince Frederick Charles, ordered a general advance of the first Army against the line of the Bistritz.

Nechanitz had about this time been occupied by the advanced guard

* 7th Division.

of the Elbe Army, under Major-General von Schöeler, and the Bistritz having been crossed above that point, but with great difficulty by two detached battalions, General von Herwarth at once pushed on to the attack of the Austro-Saxon position at Lubno and Hradek.

An attempt to cross the river at Steisskal* had failed. The bridge was broken down, and the dykes, swollen by the rain of the previous night, were unpassable by the lightest troops. It was only at Kuncitz that a second detachment, also composed of two battalions, succeeded in crossing, and was at once directed against the chateau and park of Hradek. Lubno had been carried after severe fighting, the Saxon detachments in Popowitz and Tresowitz were driven in, and at 11 o'clock nine battalions and twelve guns, with the hussar brigade and battery of horse artillery commanded by Major-General Count Goltz, were formed on the ridges extending from before Hradek to Lubno, for the attack of the main position of the Saxon corps which occupied the ground from Problus to New Prim.

In the meantime the battle had raged fiercely on the other flank. Lieutenant-General v. Fransecky, debouching from Cerekwitz, had occupied Benatek as a *point d'appui* for his advance on Cistowes and the wood of Maslowed. This was really the strongest point of the whole Austrian position. The wood of Maslowed,† sometimes called the Swip wood, or wood of Wobora, with a length from east to west of 2,000, and a depth of about 1,200 paces, domineers the whole ground, attaining at its highest point an altitude of 917 feet, 281 above the valley of the Bistritz, towards which on the north it presents a steep and overhanging face, furrowed by small ravines clothed with brushwood, the wood itself consisting partly of large trees, partly of oak-wood coppice. Forty guns, advantageously placed, swept the flanks of the ridge. To these the seventh division could oppose but eighteen, and those on ground, and at a distance, which rendered their fire almost nugatory.

The first success of the advanced guard, under Major-General v. Gordon, although eventually supported by the remainder of the division, only brought up still stronger Austrian reinforcements, until at 11 o'clock the whole of the fourth, and a considerable part of the second corps, were occupied in defending the ground they had won, preparatory to a still more energetic onslaught on the hard pressed Prussian division. As early as half-past 9 o'clock, six Prussian‡ found themselves opposed to 18 Austrian battalions of the third and fourth corps, supported by the remainder of the fourth, and the two battalions of the eighth corps, which had been left in Horinowes.

Between this hour and 11 o'clock reinforcements reached both sides, but although every battalion of the seventh division was successively thrown into the disputed wood, they were not only unable to improve their first success, but, decidedly overmatched, were forced back to its northern skirts. The losses were enormous on both sides; many

* Below Nechanitz.

† This wood was not marked on the Austrian map. Austrian writers call it the wood of Benatek.

‡ 3 of 27th Regiment; 2 of 66th Regiment; 1 of 67th Regiment.

of the mounted officers of Fransecky's division were killed, wounded, or had lost their horses; a small detachment of the twenty-seventh regiment had been cut off and taken prisoners; and the General himself, whose horse had been shot under him, having pressed forward under fire to examine the enemy's dispositions, was only saved from capture by a small party of his scattered men who had gathered to his rescue. Count Festetics had also been severely wounded by a shell splinter, which shattered his left foot, and had been carried off the field, the command of the fourth corps devolving on Major-General von Molinary, who was compelled towards 11 o'clock to request assistance from the second corps. Count Thun had already occupied ground at Horinowes with one brigade, and a great part of his artillery, and now hastened with the brigades Saffran and Würtemberg to support the fourth corps by a vigorous offensive movement against the left flank of the Prussians. The brigade Henriquez and the cavalry division of Count Taxis were left on the Trotina, but from his own statements, Count Thun appears to have been quite unconscious of the proximity of the second Prussian Army, and of the force which was so soon to be thrown on the inadequately protected flank. Fransecky had pushed his last battalion into the fight, had no expectation of any further assistance from the eighth division beyond two battalions, which had already reinforced him at Cistowes, and up to this time had heard nothing of the first corps, or of the advance of the second army. He had suffered enormous losses in officers and men, and with fourteen battalions, and twenty-four guns, found himself engaged with the greater part of two Austrian corps, and over a hundred guns, which hurled destruction into his ranks from every commanding position on his flanks and front.

I had seen the corps to which his division belongs at the previous autumn manœuvres near Merseburg. As regards *physique*, the men of the Saxon province are decidedly inferior to other corps of the Prussian Army, but as a highly disciplined and admirably-drilled body of men, they had commanded my warmest admiration. The results of this eventful day showed them to be possessed of the highest qualities of an efficient infantry, and that to the docile tractability and intelligence of the Saxon, were added the sturdy patience under fire, which we have always looked on as the peculiar characteristic of the English infantry soldier.

Here we must leave them, while we cast a glance at the centre, where the remainder of the first Army had worn out the long morning hours against the main Austrian position, fighting under the immediate observation of their much loved King. The passage of the Bistritz, which had been ordered immediately after the arrival of his Majesty on the field, was effected by an echelon movement from the left. On looking at the model, or at plans of the battle, it will be seen at once, how admirable a position for artillery is presented by an eminence called the Roskos Berg, to the south-west of the village of Sowetitz. As soon as this point and the wood of Skalka had been occupied by the sixteenth brigade, the fifteenth* received orders to

* 8th Division, 4th Corps.

seize the wood of Sadowa. This is a square of about 1,100 or 1,200 paces on each face, composed of high wood near the road, the remainder, of low, but thick brushwood. It was not held in any great force by the Austrians, who appear to have relied for its defence on the formidable artillery posted on the ridge extending from Lipa to Stresetitz, and which commanded the debouche from the wood. The fourth division moved forward from Mzan at about the same time, and was soon followed by the third from Sawadilka, in the direction of Johanneshof.

The gradual advance of the eighth and fourth, enabled Lieutenant-General von Werder, towards half-past 9 o'clock, to push the third division across the Bistritz, and attack the villages on the right bank. The sixth brigade, on the extreme right of the first Army, marched on Mokrowous and Dohalicka, while the fifth advanced over Kopanina. The defence of the Bistritz was by no means earnest; Mokrowous was carried at the first rush by a battalion of the fifty-fourth regiment, and at 11 o'clock the first Army stood on the line wood of Maslowed, wood of Sadowa, and Mokrowous, with the third corps in reserve between Ober Cernutek and the Roskos Hill, the reserve artillery on the high road between Dub and Sadowa, and with a part of the cavalry so near at hand as to be available in the event of a further advance. But it was plain that the real position lay behind the line of the Bistritz. Judiciously posted on the terraces which line the left bank of the river, and on the higher eminences which I have mentioned, the Austrians had not less than 250 guns in this part of the field, while the Prussian batteries not only suffered under the disadvantages inseparable from an advance under fire, but also from those caused by the difficult and marshy ground which limited the passage of the Bistritz to few and well marked points, and at this hour had but 72 guns to oppose to their well placed and admirably handled opponents.

Taking this as one of the best marked periods of the day,* the state of affairs may be briefly described as follows:—

On the Prussian right General von Herwarth stood prepared for an assault on the Saxon Army corps with so much of his force as he had been enabled to extricate from the narrow bridge and crowded town of Nechanitz, the line of Hradek-Lubno marking his position.

The Prussian centre had passed the Bistritz at several points, but though established in the valley was brought to a standstill by the nature of the ground and the Austrian fire.

To the left of the centre, the seventh division was exhausted by four hours of hard fighting, and every attempt to seize the wood of Maslowed was checked by a superior force, backed by an overwhelming artillery, which was then preparing for a renewed and more decisive attack on their weakened enemy.

As regards the Austrians they can be said with truth to have only now occupied their real position. All that had previously occurred might be designated as the preliminaries of the battle; their outposts had been driven in, but nowhere except at Maslowed had the infantry

* 11 o'clock.

been seriously engaged, and their losses up to this hour were probably unimportant. It does not appear that either Army had the intention to advance. Reinforcements to the Austrian batteries on the central slopes had already been asked for and refused, I believe, on the ground that a descent into the valley of the Bistritz was not contemplated, while the part to be played by the Army of Prince Frederick Charles was plainly to hold what he had, and await the arrival of the Crown Prince.

As I now propose to describe the advance of the second Army, I shall perhaps be better understood if I connect its movements in one continuous narrative, and endeavour to throw some light on events which to this hour are very imperfectly comprehended. The key to the mystery, which has been a puzzle even to military students of the campaign is the employment of so large a proportion of the Austrian Army in the operations at the wood of Maslowed, by the concentration of the fourth and of a great part of the third corps on this point, where they were held in check by fourteen battalions, far in advance of the ground on which they were intended by Field-Marshal Benedek to have been employed.

The orders despatched from Königinhof at 5 A.M. reached the Corps at hours varying with their remoteness from head-quarters. The sixth corps, which had been previously detailed for a reconnaissance on the right bank of the Elbe towards Josephstadt, was already in motion, and partially across the river at the time the order was received, a fortunate circumstance which greatly conduced to the success of the subsequent operations.

The fifth corps marched punctually at the interval* named from the departure of the sixth, and crossed the Elbe in the same direction. The Guard was nearest to head-quarters and was soon roused, while the reserve cavalry marched three-quarters of an hour after the receipt of the order at Neustadt.†

The advanced guard of the first corps lay at Chroustow, where the roar of cannon was distinctly audible, though strange to say no report had been made to the head-quarters of the corps. The order to march, which was despatched from Ober Prausnitz at 9 A.M., reached Chroustow at 9·20, and the vanguard at once commenced to move, but had not reached Gross Bürglitz at 11 o'clock. The advanced guard, followed by the reserve infantry and cavalry, was directed to move by Gross Trotin and Weiss Polikan, the main body of the corps, followed by the reserve artillery, by Zabres, Lanzow, and Sedletz.

The reserve cavalry of M. General von Hartmann, a son of Sir Julius Hartmann, who formerly served England with so much distinction, was impeded by the columns of the first corps. An attempt was made to march by Miletin, which also failed, and this important division of the second Army was reduced to a continuation of the march in rear of Bonin's troops.

Major-General von Alvensleben, who commanded the advanced

* Two hours.

† The order arrived at 8.15, the cavalry marched at 9 o'clock.

troops of the Guard at Daubrowitz and Liebthal, broke up soon after 8 o'clock, without having received the orders of his immediate Commanding Officer, in consequence of the urgent representations which had reached him from the seventh division, and marched in the direction of the now audible artillery fire in the Bistritz valley.

An Officer was sent to General von Fransecky to assure him of support, and that the troops would be at Jericek by half-past eleven, where, however, they arrived a full half hour earlier, owing to the eagerness with which the men pressed forward.

The Crown Prince, having seen the greater part of the first division of the guard pass through the town, left Königinhof soon after 8 A.M., and passing the leading battalions on their march across the plain of Daubrowitz, reached a spur of the plateau south of the village of Chotieborek soon after ten o'clock.

Little or nothing was to be seen of the progress of the battle. The view was obscured by a thick pall of fog, by the smoke of burning villages, and of the furious cannonade which was now raging between Benatek and Maslowed, and was further shut out by a bend in the valley of the Bistritz, which hid all but the mere flank of the contending forces.

Due south of the spot on which the Prince was standing, and at a distance of about three English miles across the tract of low ground lying between the Bistritz and Trotina, the high ground behind the village of Horinowes was crowned by a prominent object. Two lime trees and a tottering cross mark the site on which tradition relates that, during the Hussite persecutions, a devoted band of Bohemian Protestants met the fate which their so-called heresy had brought upon them, and sealed their fidelity with their life-blood.*

The fog had somewhat lifted, and the difficulties attending the slow advance of the troops, by miry roads, or through standing corn, afforded the Prince and his staff full time for consideration.

Certain movements of the enemy near the trees, and the partial view which was now obtained of the struggle at Maslowed, led to the conclusion that an advance in their direction would bring the second Army into the flank, nay, possibly, into the rear, of the Austrian position, and orders to that effect were immediately issued. Reports from General von Mutius, and from the fifth corps, informed him that the former had reached Welchow, and was pressing onwards in the right direction; while at 11 o'clock, the leading brigade of the latter, under Major-General von Wnuck, had already shown itself immediately in his rear at the village of Chotieborek. The first corps was known to be on the march for Gross Bürglitz, and the Guard under Prince Augustus of Würtemberg, were defiling past the ground on which he stood, and answering his words of encouragement with cheers of anticipated triumph. I was much struck with the cheeriness with which these young soldiers went into action for the second time. All *recruits*

* This tradition rests on fact, and was told to Prince Pless by an intelligent citizen of Horitz, as a well known fact, when visiting the battle-fields in the summer of 1867.

fight well in their first battle; those who afterwards brave death and wounds with cheerfulness are *soldiers*.

The first troops under fire, were the leading files of the eleventh division under Lieutenant-General von Zastrow on their reaching the high ground north of Racitz, near the point where the brook Trotinka loses course and name in the small river Trotina, and from whence their combined waters flow into the Elbe, through a broken and difficult valley, near the village of the same name. The foremost batteries of the division crossed the bridge at Luzan, and advanced to Racitz, where they opened fire at half-past 11 o'clock against the heights of Horinowes; while as nearly as possible at the same time, two batteries of the Guard came into action near the villages of Zelkowitz and Wrchownitz. The early morning orders of the Crown Prince had concentrated his Army, the flanks of which were then separated by an interval of nearly twenty miles, on a front of between eight and nine, extending from Bürglitz over Jericek and Chotieborek to before Welchow, while the advanced guards were fighting on a still more advanced and narrower front between Zelkowitz and Racitz. From this hour till nearly 4 o'clock, the sixth corps, under its much-lamented commander,—who survived the honours won for him on this day by the brave Silesians, to die of fever, two months later, on the plains of Austerlitz,—pursued an almost independent course, thoroughly in accord with the general direction of the second Army, and the plans of the Crown Prince, but at the same time so far removed, and so concealed by the undulations of the ground, that it appeared at the time like a separate battle.

With the exception of the brigade Henriquez, and of two battalions of the brigade Thom, the whole of the third Austrian corps had been drawn into the fight at the wood of Maslowed, and Major-General Henriquez was in the act of breaking up from his position near the Elbe, to march to Sendrasitz, when he was made aware that the enemy's columns were already in the neighbourhood of the Trotina valley, and were advancing on Racitz. The movement, which had already commenced, was at once countermanded, and the Major-General prepared for a resolute defence of the position.

Racitz, however, was carried by a battalion of the 50th regiment, and leaving Horinowes on his right hand, Lieutenant-General von Zastrow established himself, soon after midday, on the high ground between that village and Sendrasitz. Further to the left, Lieutenant-General von Prondzynski, with the seven battalions to which his division was reduced by the absence of two regiments in Prussian Silesia, had carried the hill of Horicka, and passed the Trotina in immediate contiguity with the left of the eleventh division.

At 12 o'clock the second Prussian Army had attained the following position:—

The detachment of the Guard, commanded by General von Alvensleben,* was advancing from Wrchownitz against Horinowes. The head of the eleventh division had carried Racitz. The twelfth division

* 4 battalions, 2 companies, 2 squadrons, 2 batteries.

was advancing from the Horicka Berg to pass the lower Trotina. The two corps had 48 guns in action.

Warned by a telegram from Josephstadt, and by the reports of Henriquez, that at least one Prussian corps was moving against his right flank, Field-Marshal Benedek had forwarded an unmistakable order to Count Thun, not only to abstain from any further advance against the wood of Maslowed, but to take up the position originally assigned to him for the defence of the right flank. To cover this change of position (right thrown back), five batteries were ordered to the heights east of Horinowics, the brigades Würtemberg and Saffran gradually drew back towards the village of Nedelist, and the brigade Thom took up a defensive position on the ridge which extends from Maslowed in the direction of Sendrasitz. Between 12 and 1 o'clock, four of the reserve batteries of the guard reached Jericek after a fatiguing, but most creditable march. Prince Hohenlohe, their commander, had conducted them with persevering energy through the tangled columns which were streaming across the narrow valley of the Elbe up the single road which led to Daubrowitz, and now brought seasonable relief to the twelve guns which had for so long maintained an unequal combat with the batteries at Horinowes. A further reinforcement was afforded by the arrival of two more batteries from the first division,* and of a battery of horse artillery, so that before 1 o'clock, 90 guns of the second Army were in action, under cover of which the advance to the plateau of Horinowics was successfully carried out. Notwithstanding the repulse of two charges of the Prussian cavalry on Austrian infantry columns near Horinowes, the infantry made steady progress, and the first division of the Guard established itself on the plateau simultaneously with the arrival of the eleventh division on the ridge north-east of Sendrasitz, and the passage of the Trotina by the twelfth.

Towards two o'clock, General von Hiller at the head of the first division of the Guard,† reached Maslowed, which had already been occupied by a battalion of the second regiment of the Guard, under Major von Petery, left the village to his right, and continued his march in the direction of Chlum; Zastrow was in full possession of Sendrasitz; and the twelfth division, which had crossed the river at the mill and village of Trotina, was pressing back the black and yellow brigade towards Lochenitz. The second, and certainly a part also of the fourth Austrian corps were at this time in the act of withdrawal, but, with the exception of unimportant detachments, the columns do not appear to have come in collision with Hiller's division, although they directly crossed his path. Field-Marshal Benedek is also reported to have ridden towards Sweti, without, however, having been made aware of the serious danger which was threatening his right wing. Although the reserve corps were warned that a change of front might be found necessary, they still remained in the position occupied by them since the commencement of the battle. The reserve artillery, on the contrary, had not

* Of the Guard.

† 1st, 2nd, 3rd, Fusiliers, Hussars, Rifles—of the Guard.

been idle. A part of it was employed in reinforcing and replacing batteries which had been so long engaged in the centre, and eight batteries were deployed on the high ground to the west of Nedelist where, in combination with forty guns of the fourth corps, they covered the movements of the two corps.

We left General von Hiller on the slope between Maslowed and Chlum, and as the second Austrian corps had at this time passed the ground over which the division was marching, and the fourth corps partially, the feeling between these corps and the third was completely lost, and the division marched through the gap. Leaving Maslowed a thousand paces to its right, the main body of the division marched directly on the church steeple of Chlum. The resistance encountered, except from the artillery, was at first by no means serious. At the field work No. 3 fourteen guns were captured by detachments of the second regiment, and of the rifles of the Guard, the former under a young Lieutenant named Chorus, who earned the order of merit by his gallantry. Two more were taken between the work and Chlum, and six near the field work No. 4, all in the first rush, while of the last-named battery a seventh gun was captured, after personal encounter with its defenders, by Colonel von Krosigk of the Hussars of the Guard, whose regiment was broken up into squadrons, and who had, therefore, remained with the divisional commander.

Excepting by the artillery not a shot was fired from the village till the assailants were close at hand; the only infantry encountered on the march, were two battalions of the fourth corps near field work No. 3, and Chlum was at once attacked on the east and south faces by the first battalion of the first regiment of the guard, while a company of rifles forced its way through the northern outlet. Chlum appears to have been garrisoned by the Brigade Appiano of the third corps. Two battalions of the regiment No. 46 (Saxe Meiningen) were in the village, the remaining battalion and the fourth rifles to the south-west on open ground, while the sixty-second regiment (Archduke Henry) extended nearly to Langenhof. It is plain that the attention of the brigade was directed to the movements of the first Prussian Army, and that the attack of the guard was a complete surprise. The troops which first reached the opposite sides of the village were overwhelmed with grape from a battery of the third corps; this was, however, carried after a heroic defence with the loss of seven guns and of more than half its men and horses. At a quarter to 8 o'clock, Chlum was in the hands of General von Hiller, and his battalions of the left wing were pushing on to the attack of Rosberitz. This was in the first instance as successful as that on Chlum, but Rosberitz was close to the position occupied by the Austrian reserves, and the struggle for possession of this village was destined to be only less memorable than that in the wood of Maslowed. The attacking troops consisted of the second battalion of the first, the Fusilier battalion of the second Foot Guards, and the third battalion of the Fusilier Guards, with two companies detached from other battalions of Hiller's division.

It will be remembered that part of the Austrian reserve artillery had been brought forward to cover the withdrawal of the second and fourth

corps. The steady advance of Hiller and Zastrow had for result the retirement of these guns, a movement which probably commenced with the right, as Major von Erckert, with the fusilier battalion of the second Foot Guards, fell in with the left battery in the act of retiring towards Wsestar, and while the escort was dispersed by one of his companies, pressed with his Adjutant and a few men into the middle of the battery, and captured two guns. The battalion continued its advance on the village, and was posted in the houses of the straggling street, the southern extremity of which abuts on the high road.

If the advance of the second Army may, and I think aptly, be likened to a wedge driven into a resisting mass, the detachment at Rosberitz may fairly be called the point of the wedge.

Here we must leave it for a while in its perilous position, while we cast a glance at the occurrences on both flanks. During the advance on Chlum, Major-General von Alvensleben, with the original advanced guard, had reached the valley lying between Maslowed and Chlum, when he suddenly became aware of columns of infantry debouching on his flank, from the direction of Lipa and Cistowes, accompanied by cavalry, and by a battery of artillery. It was the brigade Fleischacker, with a regiment of Hussars, and a 4-pounder battery which had been left in Cistowes on the retirement of the fourth corps, and was now moving on Nedelist. A scene of the wildest confusion ensued. The Hussars first lit on two companies of Engineers and two of the reserve batteries of the Guard near fieldwork No. 3, and a little further on the reserve battery of the first division, and were obliged to retire with severe loss. Accompanied by the 4-pounder battery they attempted to pass Chlum, but were received by a sharp fire from a company of rifles, and were driven in the direction of Maslowed. Here they were again received with fire from the infantry in the village, and from a battery of the Guard, and lost two guns, while those who succeeded in breaking through were shot down almost to a man, as they were careering madly down the hill in the direction of the Crown Prince and his staff, who were eye witnesses of this extraordinary episode of the fight. The remainder of the battery fell in with three detached companies of the guard near the village, and lost four guns, a part of the Hussars actually retiring towards Bürglitz. The main body of the brigade came into collision with General von Alvensleben's detachment of three battalions and a company of rifles, and were compelled to retire into the wood from whence they had originally issued, with the loss of their two remaining guns. Under the personal direction of Lieutenant-General von Hiller, Alvensleben continued his march on Chlum, where his support was most urgently required.

On the other flank Prince Hohenlohe had advanced with the reserve artillery of the guard, and occupied the ground between Chlum and Nedelist, from which the Austrian artillery had been compelled to retire by the advance of the Prussian infantry. Here he received orders from General von Colomier (commanding the artillery of the Guard), to move on Chlum, and at once took the direction of the heights south of that village. Still further to the left were four companies of

the third regiment of the Guard, in the direction of Sweti. Before returning to the centre of the battle, I will beg you to follow briefly the eleventh and twelfth divisions in their successful progress against the extreme right of the Austrian position.

The occupation of Horinowes, by the Guard, and of Sendrasitz by his main column, enabled Lieutenant-General von Zastrow to push his advanced troops against Nedelist, which was successfully carried by assault, almost simultaneously with the advance on Chlum. During the advance, the skirmishers of a battalion of the 50th Regiment, under Major von Berken, came suddenly in the high corn on the right of that long line of artillery which had played with so much effect on the advancing Prussians, and captured ten guns in fair fight, besides three which they found abandoned on the ground. The remainder of the brigade had been held fast at Sendrasitz, by the cross fire from these batteries, and from that of the brigade Henriquez, south of Trotina, and having been compelled to take shelter from the storm of missiles behind the houses, and in the hollow ways north of the village, they did not reach Nedelist till nearly half an hour later. About the same time,—which must have been three o'clock, or soon afterwards,—the arrival of the twenty-second brigade of the 8th Dragoons and 4th Hussars, and of the divisional artillery, enabled Zastrow to concentrate the whole of his division for a further advance. The twelfth division had also crossed the Trotina at the mill and railway embankment, and the two regiments of which it was composed, after making numerous prisoners in the hut-camp north of Lochenitz, had made every preparation for the attack of that place, when they were directed by the Corps Commander to hold themselves in reserve for other operations. At three o'clock the Austrian right wing, comprising the second and fourth corps, and a division of cavalry, were in full retreat on Lochenitz, Predmeritz, Wsestar, and Sweti, while the five Prussian brigades which had so fortunately achieved this success, were established on the line Chlum, Nedelist, Lochenitz, with the point of the wedge at Rosberitz, and with a reinforcement of ten untouched brigades, which were rapidly coming up in support of their somewhat perilous position. Fifty-five guns were already in their hands, and the most advanced troops commanded the great high road from Sadowa to Königgrätz. But at a distance of 2,000 paces were two unbroken corps, with a numerous artillery, massed in the hollow between Sweti, Wsestar, and Rosnitz, while three of the five cavalry divisions were immediately available. The only certain support on which Hiller could reckon, were the leading battalions of the second division of the Guard, the main body of which was still behind Maslowed; the eleventh division was at Nedelist, the fifth corps was then mounting the hill of Horinowes, and the First corps was still on the march between Wrchownitz and Benatek.

To the last-mentioned part of the field where we left Fransecky and his Saxons struggling for a foothold in the wood of Maslowed, I must now ask you to return.

Soon after eleven o'clock, a succession of furious attacks was made by the second and fourth corps on the exhausted troops, which indeed

were partially successful. Those of the fourth corps were chiefly directed against the eastern and southern, while the second corps attacked the northern side of the wood, and more particularly the strip of ground which extends like an outwork in the direction of the road from Benatek to Maslowed. The battalions, nay even the companies, were broken up; the Prussians were pressed back on both flanks, which were separated from the centre; detached parties of the second corps emerged from the north-western angle of the wood and moved on Benatek; while a renewed effort of the fourth corps from the south, and of detachments of the brigades Würtemberg and Saffran, supported by five of Thom's battalions, had for its object the capture of the Prussian stronghold, the extreme northern point of this memorable wood. But Fransecky was equal to his post, and nobly was he seconded by the Officers and men of his ever-glorious division. A Staff Officer* had also arrived from the Crown Prince with news of the second Army,—in truth still distant from the field, and embarrassed with the difficulties of a wearisome march,—still, the relief was certain, and the cry of "the Crown Prince is coming" lent new courage to the hard-pressed band.

Singular to relate, the seventh division had been all this time making prisoners, and each time that they were driven back, had carried with them the trophies of their obstinacy in numbers which almost equalled those of their own killed and wounded.† Personal direction was never wanting, and in Major-General von Schwarzhoff, and in the two Colonels, von Medem and von Blankensee, Fransecky found able and undaunted assistants. At length, between 1 and 2 o'clock an abatement in the vigour of the Austrians became perceptible, but although the corps withdrew gradually from the conflict, detachments were still left fighting in the wood, where they kept up the struggle till between 2 and 3 o'clock. During all this time the troops in Cistowes had held their ground while the hostile batteries both in front and rear, kept up the unceasing duel over their heads, until at length they were relieved by the advance of the second army. The efforts of the Austrian infantry had been most gallant and persevering, but they shattered on the unconquerable obstinacy and endurance of the more northern race. The losses of the seventh division were enormous. The 12 battalions had 84 officers, and 2,036 men *hors de combat;* of which the twenty-sixth regiment alone lost 26 officers and 709 men (a full fourth of its strength), and the two battalions of the eighth division, which fought on the right with Major-General von Gordon had 5 officers and 126 men killed and wounded; 2,000 prisoners and three colours were the trophies of this ever-memorable combat.

Towards twelve o'clock, Prince Frederick Charles, who had exercised

* Major v. der Burg.

† A battalion of the 51st Austrian Infantry which emerged from the north-west corner of the wood, so completely lost its direction that, whilst marching in loose order, it was attacked by a squadron of the 10th Prussian Hussars, under Captain von Humbert, and 16 Officers and 665 men were the results of this fortunate encounter.

a commendable prudence in resisting all suggestions for an advance beyond the Bistritz, a movement which would in all probability have resulted disastrously to the Prussian arms, thought the moment had arrived which justified the employment of his reserve. The fifth division passed the brook at Unter Dohalitz, and deployed to the right; the sixth crossed at and alongside the bridge at Sadowa, and massed itself behind the wood.

But even now the moment of advance had not arrived; all that the Prince could do was to hold the centre, and await the action of the two armies on his flanks. Nor was this to be effected without difficulty. A long period of anxious suspense had still to intervene, and the heights of Chlum and Lipa, and the wood of Sadowa were destined to be strewn with bloody witnesses of the struggle for their possession. Here the battle presented the aspect of a great artillery duel. The ground on both banks of the Bistritz was admirably adapted for the development of this arm, more particularly on the eastern or Austrian bank. Their artillery was ranged on terraces which gave them almost absolute command of the valley, and was worked with a precision and energy which foiled every attempt of the first army to advance beyond its position in the villages and meadows on the Bistritz. Towards midday the exhausted batteries of the third and tenth Austrian corps were relieved by a part of the reserve artillery,* and not less than 200 Austrian guns were simultaneously in activity on this part of the field. The Prussions laboured under one great disadvantage, I mean the large proportion of their smooth-bore guns,† which in a game of long bowls were virtually useless. It was an anxious time. News of the Crown Prince was still wanting, nor were affairs in the extreme right so far advanced, as to exercise any influence on the movements of the centre. I think great credit is due to the Prince for the cool determination with which a man of his eager and impulsive temperament played so steady a waiting game, and kept his troops so thoroughly in hand, while history will no less do justice to the bold conception, and to the untiring energy with which the Crown Prince brought his army to the very point where its action was so triumphantly decisive.

Both showed qualities widely differing from their accepted characters and dispositions, proved themselves true servants of their King and country, and soldiers of whose deeds any nation may be proud.

But if the Prussians were held fast in the position which they had won, the Austrians were equally inhibited from an advance; while after midday the perilous condition of their right flank still further forbade so hazardous an adventure.

The artillery of the second and third corps in the Prussian centre was gradually strengthened by reinforcements from the reserve, batteries which had exhausted their ammunition were replaced by others from the same source, and the duel assumed more equal proportions. But part of this was divisional, part reserve artillery; unity of command was wanting, and much ammunition was expended without any

* Said to have been 8 batteries, 64 guns.

† 36 to each corps, more than $\frac{1}{2}$, in fact, $\frac{3}{5}$ of the total number.

corresponding result. Nor was this expenditure easily replaced. The batteries had but infrequent and difficult communication with the ammunition columns. The Bistritz has few bridges, and still fewer fords, and to the disconnected action of the Prussian artillery in this part of the field was added a deficiency of ammunition which rendered the batteries partially ineffective.

The infantry of the eighth division had submitted with patience to an ordeal scarcely less trying than that of the seventh. The great importance of the Wood of Sadowa had demanded its occupation in such force as to absorb the greater part of the division, which had even been re-inforced by a detachment from the fourth, furnished by the brigade of Major-General von Hanncken.

Detachments of the sixty-first and seventy-first regiments which had established themselves in a deserted Austrian camp, and thence attempted a forward movement, were compelled to retire to the wood, and the unremitting artillery fire, which always produces a depressing influence on stationary troops, had caused serious losses to the division. Between one and two o'clock, the brigade Kirchberg of the third Austrian corps was directed by the Archduke Ernest to attempt the recapture of the wood. The attack produced no other result than that of concentrating the scattered detachments in its front, and of causing further losses on both sides. A like attempt on the part of the fourth Prussian division was frustrated by the fire of the artillery on the heights. In fact it was very like a drawn battle on this part of the field, and it may easily be imagined with how great a feeling of relief the first detachments of the Guard were observed on the hill of Chlum towards three o'clock, while it became known that the whole second army was marching to the assistance of their hard-pressed comrades.

We left the Elbe army at 11 o'clock defiling through Nechanitz under cover of the vigorous action of its advanced guard under Major-General von Schöeler. At that hour the Saxon corps had taken up a position at Problus, and awaited attack, while thanks to the facilities afforded by the neglect to defend Nechanitz and Hradek, the Prussians had seized the height of Lubno, and had deployed their batteries as a cover to the operations against the main position. The Crown Prince of Saxony, who, no less than his brave comrades, displayed qualities which won universal admiration from their opponents (and I well remember the terms of respect in which the Prussians always named both the commander and his troops), had posted his forces as follows:—

The second division, Lieutenant-General von Stieglitz, stood in a covered position behind Problus, the brigade of the body guard on the right, the first brigade on the left; the cavalry of the division maintaining the connection with the tenth Austrian corps. The second brigade, having retired from the advanced position at Lubno, Popowitz, Tresowitz, stood in reserve between Problus and Stresetitz, and the third brigade, also part of the first division, stood with three battalions in Problus. Nieder Prim was occupied by the remaining two battalions of this brigade, and by the fourth rifle battalion, of the second

division. The reserve artillery was massed in a hollow behind the first division, close to the wood which lies between Problus and Charbusitz, and the cavalry division to the left rear, also near the western skirt of this wood.

The eighth Austrian corps, as already mentioned, stood in immediate support to the Saxons, near Bor, but the two divisional 8-pounder batteries were sent forward at an early period, as a re-inforcement to the 18 Saxon guns on the ridge. The 12 guns of the Prussian advanced guard were also re-inforced by two batteries of the fifteenth division, but a glance at the plan will show that the distance (4,000 paces) at which this artillery duel commenced, rendered its effects nearly nugatory. Both lines fired at a high elevation, the shells buried themselves in the ground, and exploded innocuously.

The Saxon position was attacked on both flanks. The fifteenth division, followed by the cavalry brigade of Count Goltz, took the direction of Hradek, for the purpose of turning the position at Ober Prim; the fourteenth division (which at half-past 11 o'clock was still behind Nechanitz) received orders to march on Popowitz, and attack Problus. A reserve cavalry brigade and the sixteenth division could only be available at a much later period. The wood between Popowitz and Problus was soon occupied by a part of General Schöeler's detachment,* too weak to undertake any further enterprise, but still serving admirably as a pioneer to the subsequent advance of the fourteenth division. The two battalions which had formed the right wing of the advanced guard, and had crossed the river at Kuncitz, marched on Sterizek, the centre attacked Neu Prim, and General von Schöeler sent a part of the 40th regiment to seize the Pheasantry, in the hope that his sharpshooters might thence succeed in dislodging the hostile artillery. These scattered movements, with weak forces, did not escape the Crown Prince of Saxony, who by a vigorous attack threw back the nearest Prussian battalions on Jehlitz and Hradek, and prepared to follow up his first advantage by an energetic offensive. But the movement on Sterizek not only threatened his flank, but had alarmed the eighth corps, and, notwithstanding partial and, indeed, not unimportant successes of their opponents, the Prussians eventually succeeded in holding the position they had seized. After severe fighting, during which the Austrian brigade, Schulz, was driven back in some confusion on the Saxon line, the Prussians were firmly and advantageously established. The 68th Prussian regiment, led personally by Colonel von Gayl, its commander, who put himself at the head of the fusilier battalion, particularly distinguished itself. The first advantage gained by the Austrian brigade was not only neutralized by the determination with which this battalion threw itself on the enemy, but the remaining battalions were enabled to debouch from the wood, to deploy on its right and left, and to effect the object of establishing the Prussian line from Sterizek to Neu Prim, and of connecting Major-General von Stückradt's detachment in the latter

* It will be remembered that this advanced guard consisted of a centre and two wings, and was of considerable strength. This was the detachment which crossed the Bistritz, *above* Nechanitz, 2 companies 28th Regiment, 1 battalion 17th Regiment, Rifle Battalion No. 8.

village with the adventurous right wing of the advanced guard. Neu Prim was occupied by the Prussians, and a second attempt to dispossess them resulted in the Austrian brigade being driven back on Problus and the wood of Bor. Major-General Schulz was killed, and 1,000 prisoners fell into the hands of the captors. Both sides now prepared for a further and more embittered struggle. The threatened flank of the Saxon corps was strengthened by the first brigade, which took up a position between Problus and Charbusitz, behind which the remains of the brigade Schulz were gathered in support, the artillery was re-inforced, and the two brigades of Saxon cavalry, with a battery of horse artillery, joined Edelsheim's cavalry division with the view of operating on the right flank and rear of the Prussians between Techlowitz and Radikowitz. The Prussians also gathered their forces for the attack, and exertions were made to supply the deficiency under which Lieutenant-General von Canstein* had hitherto laboured from the late arrival of the artillery. The batteries on the high ground at Lubno were pushed forward to within two thousand paces of Nieder Prim, and paved the way for the attack on that village. Bit by bit, its defenders were driven back, and, at about half-past 1 o'clock, the fourteenth division had disengaged itself from the defile of Nechanitz, and was formed behind the ridge at Lubno for the attack of Problus, for which both divisions were in perfect readiness at half-past 2.

The Crown Prince of Saxony, threatened by the steady advance of the division, Canstein, on his left, and by the appearance of Münster's division in his front, aware also, from his commanding position, of the arrival of the second Prussian Army, of the combat which was raging, in and about Chlum, and of the movements of the tenth Austrian corps under Gablenz, appears to have made preparations for retreat simultaneously with the contemplated advance of the Elbe Army. Reinforced by the arrival of their artillery, encouraged by the example of their Generals and Commanding Officers, and by the inspiriting strains of their regimental bands, the two divisions carried their concentric movement to a successful issue, and soon after three o'clock the Prussian right wing had full possession of the heights, and threatened the retreat of the left wing of the combined Saxon and Austrian Armies.

But the Saxons had fought well and obstinately, retreated in admirable order, and earned a respect which their adversaries were most ready in acknowledging and expressing.

About this time General von Herwarth, who had taken personal share in the attack on Problus, received the following memorandum from General von Moltke :—

"Crown Prince at Zizelowes.† Retreat of the Austrians cut off from "Josephstadt. It is of the greatest importance that General von Her-"warth should push forward on the opposite flank, as the Austrians "still hold their ground in the centre.

"At Sadowa, 1¾ o'clock.

(Signed) "VON MOLTKE."

* Commanding 15th division.

† This can only have referred to the 1st Corps, which was the only part of the 2nd Army whose arrival was likely to be observed from Sadowa.

The Elbe Army had fulfilled the arduous undertaking of marching fifteen miles from its bivouacs, over roads which increased the difficulties of the advance, and through so narrow and tortuous a defile at the town of Nechanitz, that the sixteenth division and five batteries of the reserve artillery only struggled through after seven weary hours of delay.

Herwarth's success was not obtained without severe loss. The 68th regiment lost 4 Officers and 140 men in the fight at Ober Prim; the fusilier battalion of the 56th regiment, 12 Officers and 200 men; while the four battalions of the 27th brigade had 4 Officers and 67 men killed outright, 17 Officers and 300 men wounded in the attack of the position at Problus. The Saxons still held the wood to the east of Problus, which was only taken after a renewal of the combat by the 28th brigade and a detachment from the fifteenth division, when the Saxons and the remnants of Schulz's brigade took post near Rosnitz, on one side of the wood, and the brigades, Roth and Wöber,* established themselves under cover of the further side of the wood near Charbusitz. An attempt was made to re-capture Problus. Stresetitz was still occupied by the Austrian artillery, and under cover of its fire, the brigade Piret of the first corps, which was detached for this purpose, advanced against the village, while Schwarzkoppen's brigade was in the act of assembly. The skirts of the village at first succumbed to this attack, only to make the repulse more decisive, and, at 4 o'clock, General von Herwarth was so far relieved from the enemy in his front, that he was enabled to direct his attention to the assembly of the fourteenth and fifteenth divisions; the 27th brigade in Problus; the 28th in the western skirts of the wood and at the farm of Bor; while Lieutenant-General von Canstein collected nine battalions in a position to the right front of the fourteenth division. Problus was burning furiously, but was occupied by its captors notwithstanding the fire still directed against it from the batteries of artillery near Stresetitz.

We left the guard at three o'clock, in full possession of Chlum and Rosberitz, but standing almost unsupported in face of a reserve of two corps of infantry and of seventy squadrons of the highly disciplined cavalry, of which Austria was with justice so proud. It was only now that Field-Marshal Benedek became aware of the advent of the second Army. On riding towards Chlum, he was received with a fire of musketry, which wounded several members of his staff and escort, among them Count Grünne, one of his Aides-de-Camp, and he learnt about the same time that Rosberitz had fallen into the hands of the enemy. A brigade of the first corps was despatched to the assistance of the Saxons, and the Field Marshal directed his attention to the recovery of the strongholds which had been so unaccountably lost. It was at about the same time that the Prussian head-quarters became aware of the more favourable aspect of affairs which now presented itself. The flashes from the guns of the second Army had been observed from the Roskos Berg, and the columns had been seen in movement on the slope of Horinowics, but what brought the greatest certainty to the Prussian

* 8th Austrian Corps.

staff was the gradual cessation of the assaults in the wood of Maslowed, and a visible abatement of the artillery fire along the whole of the line. With unimportant exceptions, the Austrian infantry was concealed behind the ridges, but the gradual slackening of the artillery fire, without any corresponding movement of the infantry in advance, led irresistibly to the conclusion that the latter was preparing to retreat, and at half-past 3 o'clock the King gave orders for the advance of the first Army.

It may give an idea of the extraordinary confusion of the integral parts of the Armies, when I mention that the wood at Lipa was still held by a brigade of the third Austrian corps, and by detachments of the fourth, which not only kept up a vigorous fire on the west of Chlum, but made preparations for the assault of the village, while another detachment of the fourth corps still had possession of a part of Cistowes. Cistowes was captured by the Guard, and by detached parties of the seventh division, but not till after the wood of Lipa had fallen into the hands of the Prussians, having succumbed to a combined attack from all sides under the direction of Major-General von Alvensleben. Its defenders drew off towards Lipa and Langenhof, leaving 1,600 prisoners behind them, but carrying off their wounded Commander, Colonel von Benedek. Scarcely had the wood been carried by the Prussians, when Austrian columns were perceived in full march against the heights of Chlum. Apparently a whole brigade, they crossed the high road between Rosberitz and Lipa,* unchecked by the Prussian fire from Rosberitz, and climbed the hill with a gallantry which only resulted in a fearful loss. The Prussian infantry detachments of the Guard reserved their fire till the leading files were within a hundred yards of the weak line of less than five companies.† Two well directed vollies and a withering file fire from the destructive needle-gun brought the columns to a halt, and finally drove them across the high road in the direction of Langenhof. The third Austrian corps, which had fought with great resolution under the Archduke Ernest, was completely broken up: the brigade Appiano had been defeated at Chlum; another, in the unfortunate attempt to retake the wood of Sadowa; the brigade Benedek in the wood of Lipa; and the brigade Prohazka, which stood in reserve at Langenhof, had already commenced its retreat. The artillery of the corps still held the position which it had taken at the commencement of the battle, and notwithstanding the withdrawal of the infantry, kept up a vigorous fire against the first Prussian Army. But, however successful on the right, the Prussian Guard was destined to a reverse on the left, resulting, after a stern and gallant resistance, in the recapture of Rosberitz by the Austrian reserves.

* From a statement in the January number of Streffleur's Military Journal, it appears that Gondrecourt attacked Chlum and Rosberitz with the brigades Ringelsheim, Poschacker, and Leiningen, of the 1st Corps, at about the time when Piret was detached to the assistance of the Saxons, while the brigade Abele was moved to Langenhof.

† 1st, 4th, and part of 7th Company of 2nd Regiment; 3rd and a sub-division of the Fusiliers; half a company of 1st Regiment and a sub-division of 3rd company 2nd Regiment as reserve.

The garrison which defended this important post, composed of the Fusilier battalion of the 2nd Guards, under Major von Erckert, occupied the southern skirts of the village with three companies, the fourth being posted with the third battalion of the Fusilier Guards under Major Count Waldersee on the western, while a battalion of the first regiment of the Guard under Lieutenant-Colonel von Block, held the eastern side of the village. Three companies of the 1st and 3rd Guards, which had become detached from the main body of the division during the advance on Chlum, joined the defenders of the village, and proved a seasonable reinforcement. More than 100 Austrian guns, a great part of which were deployed in a half circle between Wsestar and Langenhof covering the movements of the reserve, overwhelmed the village and its approaches with a shower of missiles of every description, and (for a time) effectually delayed the co-operation of the Prussian artillery.

Four separate attacks on the west of Rosberitz failed under the fire of its defenders, and at about half-past three the divisional artillery established itself on the hill of Chlum. Prince Hohenlohe had also succeeded, after two checks in his wearisome march, in bringing up the reserve artillery of the guard to a favourable position on the ridge; that of the sixth corps had also pushed forward from Nedelist, and fired on the flank of the Austrian line, the Guard artillery directing its fire mainly on the now plainly visible columns of the reserve. But this was not effected without important losses—one battery was silenced, and was compelled to withdraw from its position.

Warned by the failures on the west of Rosberitz, three massive columns, supposed to have been detached from the sixth corps,* were now launched against the southern and projecting end of the village, which was attacked simultaneously on both sides by an overwhelming force. The companies under Erckert were already reduced to half their original numbers, and had exhausted their ammunition in an unceasing exchange of shots with the Austrian riflemen in their front, Erckert fell dangerously wounded from his horse, and the remnant of his battalion was at length driven into the interior of the village, leaving their brave Commander in the hands of the enemy. A still fiercer combat succeeded in the interior of the village. The struggle was continued at duelling distance, Lieutenant-Colonel von Heldorf of the First Guards fell dead, Prince Anton of Hohenzollern was dangerously wounded, and notwithstanding all efforts of Count Waldersee, and of the brave fellows under his command, the Prussians were eventually driven out, with the loss of considerable numbers in killed and wounded, and of 70 prisoners.

Colonel von Obernitz, commanding the brigade, had been wounded in the head at the commencement of the first attack on Rosberitz, and the colour of Erckert's battalion was only saved from capture by the exertions of its bearer, Serjeant Gursch, and of three young Officers who came to his rescue.

The captors of Rosberitz endeavoured to debouch from the village,

* More probably 1st, see note above.

but in vain. The fire of infantry and artillery on the plateau of Chlum drove them back with fearful losses, a battery showered canister on their flank, and they were compelled to retire again to the village, leaving the slopes of Chlum strewn with killed and wounded, testimonies to the severity and perseverance of the conflict.

The reserve artillery of the Guard, which had nearly exhausted its ammunition, and had lost 50 horses, was obliged after four o'clock to be temporarily withdrawn, and retired to the crest of the nearest hill. The losses of the Guard were heavy, and had fallen chiefly on the first division. The Aide-de-Camp of the Divisional Commander* had fallen, and the total amounted to 38 Officers and more than 1,000 men, of which the first regiment had lost 13 Officers and 380 men, and Erckert's battalion of the second, 6 Officers and nearly 200 men. But support was near at hand. The head of the second division had already produced important results at Cistowes and Lipa, and still further relief was now fast approaching Chlum in the advanced guard of the first corps under Lieutenant-General von Grossmann, consisting of seven battalions of infantry,† a brigade of cavalry, and two batteries.

Passing Maslowed, which was even then not clear of the enemy, Lieutenant-General von Grossmann directed his march on Chlum and Lipa, where his arrival was most opportune. As the commander of the 1st rifle battalion was in the act of reporting to General von Hiller, the latter was struck in the breast by a splinter of shell, fell from his horse, and died as he was carried to the rear. Lieutenant-General von Grossmann at once assumed the command at Chlum, two attempts of Austrian infantry were successfully repulsed, and the 4-pounder batteries which accompanied his advance guard were enabled to take up a position between Chlum and Lipa, from which they fired with murderous effect on the Austrian masses, which were at length compelled to take refuge in Rosberitz.

Soon after 4 o'clock, General von Grossman gave orders to the combined detachments at Chlum to descend the hill and recapture the village. As they were in the act of so doing, a long line of cavalry was observed advancing from the direction of Sadowa, which proved to be that of the first Army, at its head Major-General Count Gröben and the 12th Thuringian Hussars.

It was now plain that the Austrian centre had been driven in; and the recapture of Rosberitz may rather be attributed to the general withdrawal of the Army than to the success of any direct assault of the Prussians. In fact the day was lost, and had been so virtually since half-past 2 o'clock, both wings were in full, but by no means hurried, retreat, and all that now remained to Field-Marshal Benedek was to draw off with the least possible loss, and to keep the advancing enemy at bay till darkness covered his movements.

Notwithstanding repeated attacks of the Haller Hussars, Zastrow had succeeded in assembling the eleventh division at Nedelist. Relieved by the withdrawal of the second corps across the bridges at Lochenitz

* Lieutenant The-Losen.
† 1st Regiment, 41st Regiment, 1st Rifle Battalion.

and Predmeritz,* and of the second light cavalry division, which followed the movements of this corps, General von Mutius was enabled to direct the whole force under his command to the assistance of the centre. It was at this period of the day that the 4th Prussian hussars, while covering the left of Zastrow's division during the advance from Sendrasitz on Nedelist, had an unfortunate encounter with the Austrian cavalry. The regiment, which formed part of a combined brigade under Lieutenant-Colonel von Wichmann of the 8th dragoons, had already broken into the gallop when it fell suddenly into a hollow way, previously concealed from view by the high corn. Attacked in turn by the Palffy Hussars, and exposed also to the fire of a battery near Lochenitz, the regiment was only extricated from its difficulties after the loss of nearly 50 men, and as many horses.

The eleventh division, making a change of front half right, received orders to march on Rosberitz, Wsestar, and Sweti, as soon as the progress of the twelfth afforded full cover to its left. This movement was successfully executed. The twenty-second brigade marched on Rosberitz, the twenty-first on Wsestar and Sweti, where it again encountered a brigade of the fourth corps under the Archduke Joseph. The village† was carried after a stout resistance at about half-past four o'clock or a little later, and the Austrian brigade continued its retreat as a cover to the reserve artillery.

The Elbe Army had also continued to press back the retreating left wing of the enemy, but had not succeeded in cutting his line of retreat towards the high road. Few trophies were gathered on this part of the field, beyond the prisoners which had been made in the earlier attacks on the position at Problus, and the villages of Prim.

It was during the progress of these operations that the general advance of the first Army, as directed by the King at half-past 3 o'clock, became evident.

The assistance of the cavalry was almost simultaneously demanded by the commanders of the second and third corps. Two brigades were at once pushed to the front, commanded respectively by Major-Generals Count Gröben,‡ and Duke William of Mecklenburg, both composed of light cavalry, with the exception of one regiment of Lancers (the 11th) which formed part of Duke William's brigade. With the former, which crossed the river at Sadowa, Prince Frederick Charles himself advanced; with the latter§ Prince Albrecht, youngest brother of the King, who commanded the great cavalry reserve; while the King, impelled by an eager impetuosity, of which few men are capable in the seventieth year of their age, placed himself at the head of his advancing troops, and rode keenly forward towards the thickest of the battle. The long-hoped-for, long-expected moment had

* The 2nd Corps, as I learn from a narrative, published in January, 1867, by its Commander, Count Thun Hohenstein, lost during the day 6,138 Officers and men, its strength having been 29,524 of all ranks.

† Sweti.

‡ Count Gröben is the brother of an officer who made the campaign of 1845 on the Sutlej with our army, in attendance on Prince Waldemar of Prussia, and who died of fever caught in Schleswig in 1864.

§ This brigade crossed at Sowetitz.

at length arrived, which was to put an end to the anxieties of hours, and to bring the reward of patience and endurance.

The difficulties attending the passage of the Bistritz must not be underrated. The advancing cavalry was mixed up with masses of infantry, and trains of artillery, in such a manner that its formation was completely broken up, and the regiments came singly into the fight.

Gröben's brigade, which followed the line of the high road, took advantage of open ground to the south-east of the wood of Sadowa, and advanced in two columns past Langenhof in the direction of Rosberitz, the Thüringen Hussars on the left, the Neumark Dragoons on the right.

Near this village, the General who had hastened on in front of his brigade, caught sight of a retiring mass of the enemy, while at the same time he perceived the Prussian columns descending the hill of Chlum in the direction of the village. In support of this movement, he ordered the Hussars to incline to the left and attack to the front, the Dragoons to follow in reserve. The Hussars deployed, and attacked with success, riding over the infantry and capturing four guns, though not without loss from the infantry fire, Count Gröben himself being severely wounded in the *melée*.

The Neumark Dragoons were not so fortunate. In the confusion inseparable from passing the infantry and artillery now pressing forward from the valley of the Bistritz, the main body of the Dragoons, three squadrons under their Lieutenant-Colonel, had become separated from the two squadrons which followed the Hussars in support, and had taken the originally designated direction of Stresetitz. It was while they were thus detached that a dense mass of the enemy's cavalry was suddenly observed approaching from Rosnitz, which proved to be the heavy cavalry division of Prince Schleswig Holstein, consisting of the Brigades Schindlocker and Prince Solms, accompanied by a small detachment of Hussars. To cover the re-assembly of the now scattered Thüringians, the fourth and fifth squadrons of the Dragoons, assisted by such of the Hussars as had been hastily rallied, threw themselves on the head of the hostile column, and as a natural consequence were punished for their temerity, by being driven with loss in the direction of Langenhof. Part of the Austrian cavalry was driven back by the fire of infantry from a farm-house on the high road, but the remainder followed in hot pursuit till checked by an attack of the fourth (Pomeranian) Lancers, which caused them to break off to their left, and brought them under the fire of detachments of the Guard, and of the second and third corps which occupied the village, and a sheep-fold immediately south-east of it. One regiment of heavy cavalry, believed to have been the Ferdinand Cuirassiers* of Prince Solms' brigade, had followed Schindlocker's left flank in a somewhat retired eschelon, and in perfect order. Passing a little to the southward of the village, from whence they received fire from the infantry, they met the leading divisions of the Zieten Hussars, and a sharp

* It is incorrect to call the Austrian heavy cavalry Cuirassiers, as they wear no cuirass; they are heavy dragoons, and so, I believe, they are now called.

encounter took place. Still further to the south the remainder of the Hussars, under the personal direction of Duke William, and three half squadrons of the 4th Lancers became involved with another body of Austrian Cuirassiers, supposed to have been the remainder of Prince Solms' brigade.

Till we receive more reliable accounts from Austrian sources, it is hard to say who had the best of it. Certain it is, however, that whatever was their reception, the Prussian light cavalry did not avoid the encounter with the Austrian Cuirassiers, and that the Austrian cavalry fought under the disadvantage of being driven by the varying phases of the combat under the fire of the enemy's infantry, before which, and the attacks of the cavalry, they eventually withdrew, part towards the wood of Bor, part towards the village of Rosnitz. The two squadrons of the 3rd Dragoons lost 4 Officers, 3 cadets, and 96 men; the 12th Hussars 4 Officers and 45 men; the 4th Lancers 6 Officers and 80 men; and the 3rd Hussars 15 men in this succession of encounters, in which the Prince Albrecht of Prussia, and the divisional Commander, Major-General von Hann, personally assisted.

The remaining squadrons of the 3rd Dragoons had, as I have before mentioned, continued to advance in the original direction to the right of Langenhof. Lieutenant-Colonel von Willisen, after passing through a trying fire from the Austrian batteries, reached Stresetitz, near which village he waited for the opportunity to attack with advantage. But few minutes had elapsed, when he became aware of the approach, from Rosnitz, of a greatly superior force of Austrian cavalry, and withdrew towards Stresetitz, which was occupied by detachments of the third Army Corps. Encouraged however by the approach of a regiment of Lancers, and relying on their support with a confidence which was fully justified, he wheeled up the divisions, formed line, and bore down obliquely on the advancing Cuirassiers at a trot. A furious *meleé* ensued. The three squadrons found themselves engaged with two complete regiments of Cuirassiers, which enveloped them in flank and rear, and would probably have suffered still more severely, had not the Austrian support been checked by the fire from the Prussian infantry and artillery at Stresetitz. As it was, the Dragoons lost 8 Officers and 92 men, their total losses during the battle amounting to 12 Officers, 189 men, and 87 horses. The Cuirassiers were in the first flush of their success, when Prince Hohenlohe,* at the head of the 11th Lancers, swept down on their broken line at a sharp gallop, shattered its formation, and effected the complete discomfiture of the brigade. The Austrian losses were very severe, Prince Windischgrätz, who commanded the brigade last mentioned, fell severely wounded into the hands of the Prussians, and four Colonels were wounded in the succession of combats which I have narrated, while the scene of the encounter was strewn with the relics of these fine regiments. Bravest among the brave was a countryman of our own, Major Beales, whom I afterwards heard of as lying wounded at the château of Hradek, and whose good conduct on the field won him promotion to higher

* Brother of the Commander of the Field Artillery of the Guard.

rank, and the decoration of the Iron Crown. Still further to the right* the remaining brigade of Count Coudenhove's division also came into collision with the 1st Dragoons of the Prussian Guard, and the 5th Hussars, the former part of the brigade Rheinbaben, of the cavalry reserve, the latter part of the divisional cavalry of the second Army corps. The attacking lines rode through and through each other with varying success, and a body of Austrian Lancers made so near an approach to the position occupied by the King of Prussia within 300 yards of Stresetitz whence His Majesty had witnessed these exciting conflicts, that one of his staff hastily formed the head-quarter guard to ward off the impending danger. It was all, however, of no avail. The Prussian Armies were now in full onward movement, Rosberitz and Wsestar were already in their hands, the artillery had extricated itself from the valley, and was sweeping the plain in every direction; the circle was growing narrower with each passing minute, and all that remained to these noble troops, was to follow the disorganised mass, whose retreat they had secured by their bravery and self-devotion.

The Austrian artillery, which had throughout the battle been handled in a manner which impressed me more deeply than any circumstance of that eventful day; which threw away no chance; which fought its guns with an ability deserving of the highest praise, and with a bravery which should never be forgotten, had taken up a position near Rosnitz, from which however, the steady advance of the Prussian guns in a gradually narrowing circle, eventually compelled it to retire. Rosberitz was recaptured at about half-past 4 o'clock by detachments from the guard and from the first and sixth corps, while the remainder of Zastrow's division had occupied Wsestar, and was pushing on towards Rosnitz and Briza.

At 5 o'clock the Crown Prince met Prince Frederick Charles on the heights of Chlum; here the two leaders of the Prussian armies embraced each other, with kindly words of thanks and welcome, amid the exciting cheers of the surrounding soldiery, the spattering fire of musketry from the villages on the high road, and the sullen roar of the lines of hostile artillery.

With the capture of Briza, and the establishment of the Elbe Army at Bor, the front of the battle had contracted to little more than two English miles. To the right Lieutenant-General von Etzel, with a weak detachment of the sixteenth division, was moving on Charbusitz, where he was brought to a stand-still by the superiority of the Austrian fire from high ground to the west of Stösser. The Prussian guns were compelled to withdraw for a time before the fire directed on them, were re-inforced and again advanced, until towards half-past 6 o'clock, the second and Elbe armies joined their flanks in front of the first Army, occupied Sterizek and Charbusitz, Klacow, and Briza, while advanced detachments stood in the vicinity of Stösser and Ziegelschlag. Further attempts at pursuit of the Prussian cavalry were defeated by the determined attitude of the Austrian artillery, which still covered

* Prussian right.

the withdrawal of their broken Army, and soon after that hour, orders were issued to the Prussian troops to remain on the ground which they occupied, by the following memorandum :—

"To-morrow will be a day of general rest, and only such movements "will be undertaken as are necessary for the convenience and re-"assembly of the troops. The outposts, towards Josephstadt, are to be "furnished by the second, those towards Königgrätz by the first Army, "and the forces under the General of infantry, von Herwarth, will, as "far as possible, carry out the pursuit of the enemy in the direction of "Pardubitz. The division of Landwehr of the guard is to move on "Chlumetz.

(Signed) "VON MOLTKE.

"Near Königgrätz, the 3rd July, 1866,
6½ o'clock P.M."

His Majesty the King, undeterred by the fire of the enemy's artillery, took post, towards the end of the battle, to the east of the wood of Charbusitz, whence he watched the last movements of the retreating Austrians.

From Chlum the Crown Prince had issued orders to General von Steinmetz to take up the pursuit with the fifth corps. These orders reached the General at about six o'clock, when close to Rosberitz. Similar orders to the reserve cavalry of the second Army, though despatched in duplicate, failed to reach the divisional Commander, and though Major-General von Hartmann with one brigade joined the advancing fifth corps, the two other brigades of his division were left at Rosberitz. Towards 8 o'clock the fifth corps and the cavalry brigade reached Klacow, where a stop was put to their further movements, after a march of twelve hours, by the direct order issued from the Prussian head-quarters.

At about the same hour the Crown Prince, attended by a small remnant of his staff, which had been gradually diminished by the despatch of orders, and by the weariness of horses which were no longer capable of moving out of a walk, encountered the head-quarter staff in a meadow between Problus and Langenhof. A more impressive scene has seldom been witnessed. The King, warned of the approach of his son, turned his horse, and riding through his staff, met him in the open space between the two parties of horsemen. Such moments are rare in any life, and the spectators of the interview may well be excused for the tears of emotion that filled all eyes. The Crown Prince had repeatedly kissed his Majesty's hand, when the King, opening his arms, father and son were wrapt in a mutual embrace. As they turned away in a proud attempt to master their emotion, the King, holding out the Cross of Merit, thrust it into the Prince's hand with these words, "Take it, for you have deserved it,"—it was a complete surprise, the telegraphic communication that the cross had been conferred for the victories of the preceding week, having fallen into the hands of the Austrians. Another warm embrace, and a few words of broken thanks, brought the affecting interview to a close. The Crown Prince presented to the King, Generals von Blumenthal and

[illegible] his Chief of the Staff and Quartermaster-General, and the [illegible] mingled in mutual congratulation. The very ground on [illegible] meeting took place was strewn with the dead and wounded, [illegible] sun shed its rays full on the group, while far away, towards [illegible] and the great southern high road, was heard the distant [illegible] noble artillery which, whatever its misfortunes and losses [illegible] won on that day the admiration and respect of all who [illegible] to its fire.

[illegible] Army bivouacked at Sterizek, Ober, Nieder Prim, and [illegible] the head-quarters were established. The first Army [illegible] Westar, Langenhof, Stresetitz, Chlum, and Lipa; [illegible] remained at the Roskos Berg, the reserve artillery [illegible] Kleuitz, and the two divisions of the reserve cavalry [illegible] respectively at Rosnitz and Nechanitz. The second Army [illegible] the first and fifth corps, ground on each side of Rosnitz; [illegible] remained at Briza and Sweti; the Guard between [illegible] and Langenhof; and Hartmann's cavalry division, between [illegible] The King and Prince Frederick Charles returned [illegible] they passed the night, the Crown Prince to Horinowes, [illegible] the respective head-quarters remained on the follow-

[illegible] Officers, and 8,794 men, killed, wounded, and [illegible] the Austrians amounted to 44,200 of all ranks,* [illegible] prisoners into the hands of the victors. The [illegible] 160 Austrian, and 1 Saxon gun, and a mass of [illegible] which almost exceeds belief. The muskets must be [illegible] the ammunition and baggage-waggons by hun- [illegible] trains and a field-telegraph were found [illegible] ground near the fortress of Königgrätz.

APPENDIX.

[illegible] OF THE PRUSSIAN ARMIES, ON THE 3RD OF JULY. 1866.

[illegible]-in-Chief, His Majesty the King.

[illegible]-in-Chief, H.R.H. the Prince Frederick [illegible]

[illegible]-General von Schmidt.

[illegible] Lieutenant-General von Werder.

[illegible] Major-General von Jannschowsky, 42nd [illegible]

[illegible] von Winterfeld, 54th regiment, 14th [illegible]

[illegible] General Herwarth von Bittenfeld.

* [illegible] wounded, 25,419 missing.

7th Brigade.—Major-General von Schlabrendorff, 9th regiment, 49th regiment.

8th Brigade.—Major-General von Hanneken, 61st regiment, 21st regiment.

3rd Heavy Cavalry Brigade.—Major-General Baron von der Goltz, 9th Lancers, 2nd Cuirassiers.

Attached to Divisions.—5th Hussars, 4th Lancers, 2nd Rifles, and 2nd Engineers.

13 batteries of the 2nd regiment of Field Artillery.

5th Division.—Major-General von Kamiensky.

9th Brigade.—Major-General von Schimmelmann, 48th regiment, 8th regiment.

10th Brigade.—Colonel von Debschitz, 18th regiment, 12th regiment.

6th Division.—Lieutenant-General von Manstein in command of both divisions.

11th Brigade.—Major-General von Gersdorff, 35th regiment, 60th regiment.

12th Brigade.—Major-General von Kotze, 64th regiment, 24th regiment.

Attached to Divisions.—3rd Rifles, two companies; 3rd Engineers.

8 batteries of the 3rd regiment of Field Artillery.

7th Division.—Lieutenant-General von Fransecky.

13th Brigade.—Major-General von Schwarzhoff, 66th regiment, 26th regiment.

14th Brigade.—Major-General von Gordon, 27th regiment, 67th regiment.

8th Division.—Lieutenant-General von Horn.

15th Brigade.—Major-General von Bose, 31st regiment, 71st regiment.

16th Brigade.—Major-General von Schmidt, 72nd regiment.

Attached to Divisions.—10th Hussars, 6th Lancers, 4th Rifles, three companies 4th Engineers.

8 batteries of the 4th regiment of Field Artillery.

Attached to 1st Army.—Cavalry Corps, H.R.H. Prince Albrecht of Prussia.

1st Cavalry Division.—Major-General von Alvensleben.

1st Light Cavalry Brigade, Major-General von Rheinbaben.

1st Dragoons of the Guard, 1st Lancers of the Guard, 2nd Lancers of the Guard, 1 battery of Horse Artillery.

2nd Heavy Cavalry Brigade, Major-General von Pfuel.

6th Cuirassiers, 7th Cuirassiers, 1 battery of Horse Artillery.

2nd Cavalry Division.—Major-General Hann von Weyhern.

2nd Light Cavalry Brigade.—Major-General Duke William of Mecklenburg Schwerin.

3rd Hussars, 11th Lancers, 2nd Dragoons of the Guard, 1 battery of Horse Artillery.

3rd Light Cavalry Brigade.—Major-General Count von der Gröben.

3rd Dragoons, 12th Hussars, 1 battery of Horse Artillery.

Combined Cavalry Brigade.—Major-General Count von Bismarck-Bohlen, 2nd Dragoons, 3rd Lancers.

Reserve Artillery of the First Army.—Major-General Schwarz, 8 batteries of the 3rd, and 8 of the 4th Army Corps.

Elbe Army.—General Herwarth von Bittenfeld.

Advanced Guard.—Major-General von Schoeler commanding 31st brigade, 1 battalion each of 17th, 28th, 33rd, 40th, 56th, and 69th regiments, the 8th Rifles, two batteries of Field Artillery, and a company of Engineers.

Cavalry Brigade.—Major-General Count von der Goltz, 11th Hussars, 7th Hussars, 1 battery of Horse Artillery.

14th Division.—Lieutenant-General Count Münster Meinhövel.

27th Brigade.—Major-General von Schwarzkoppen, 16th regiment, 2 battalions 56th regiment, 7th Rifles.

28th Brigade.—Major-General von Hiller, 2 battalions 57th, 2 battalions 17th regiment.

15th Division.—Lieutenant-General von Canstein.

29th Brigade.—Major-General von Stückradt, 2 battalions 40th, 2 battalions 65th regiment.

30th Brigade.—Major-General von Glasenapp, 68th regiment, 2 battalions, 28th regiment.

Reserve Cavalry Brigade.—Major-General von Kotze, 8th Cuirassiers, Pommeranian Landwehr Cavalry.

Combined Reserve Artillery.—6 batteries of the 7th, and 6 of the 8th Army Corps.

Attached to Divisions.—5th Lancers, 7th Dragoons, six batteries of the 7th and 8th Field Artillery regiments, two companies of Engineers.

As covering force to the Reserve Artillery.—1 battalion, 57th regiment.

16th Division.—Lieutenant-General von Etzel.

Fusilier Brigade.—Colonel von Wegerer, 2 battalions 33rd regiment, 34th regiment.

31st Infantry Brigade.—Colonel Schuler von Senden (temporary), 29th regiment, 2 battalions 69th regiment.

Attached to Division.—7th Lancers, 3 batteries of the 8th field artillery regiment, 1 company of the 8th Engineers.

Infantry Division of Landwehr of the Guard.—Major-General von Rosenberg, 4 regiments (11½ battalions), 1 cavalry regiment, 2 reserve batteries.

Second Army.—Commanding-in-Chief, H.R.H. the Crown Prince of Prussia.

Corps of the Guard.—H.R.H. General Prince Augustus of Würtemberg.

1st Guard Division.—Lieutenant-General Hiller von Gaertringen.

Advanced Guard.—Major-General von Alvensleben.

2nd Guard Brigade.—Colonel von Pape, 2 companies rifles of the Guard, 2 battalions 2nd Foot Guards, 2 battalions Fusilier Guards, 2 squadrons Hussars of the Guard, 2 batteries of Field Artillery.

1st Guard Brigade.—Colonel Knappe von Knappstädt, 2 battalions 3rd Foot Guards, 2 battalions 1st Foot Guards.

Fusilier Brigade.—Colonel von Kessel, 1 battalion 2nd Foot Guards, 1 battalion 1st Foot Guards, 1 battalion Fusilier Guards, 2 squadrons Hussars of the Guard, 2 companies Rifles of the Guard, 2 batteries of Field Artillery.

2nd Division of the Guard.—Lieutenant-General von Plonski.

Advanced Guard.—Colonel von Pritzelwitz, battalion of Sharpshooters of the Guard, Fusilier Battalion of the Regiment Emperor Francis, Fusilier Battalion of the Regiment Emperor Alexander, 3rd Regiment Lancers of the Guard, 1 battery of field artillery, 1 company of Engineers of the Guard.

3rd Brigade of the Guard.—Major-General von Budritzki, 2 battalions Emperor Alexander, the regiment of the Queen Elizabeth, 1 battery of Field Artillery.

4th Brigade of the Guard.—Major-General von Loën, the regiment of the Queen, 2 battalions Emperor Francis, 2 batteries of Field Artillery.

Reserve Cavalry.—1st Heavy Cavalry Brigade, H.R.H. Prince Albrecht (son) of Prussia, regiment of Garde du Corps, regiment of Cuirassiers of the Guard, 1 battery of Horse Artillery.

Reserve Artillery.—Colonel Kraft Prince of Hohenlohe Ingelfingen, 5 batteries of Field Artillery of the Guard.

First Army Corps.—General von Bonin.

1st Division.—Lieutenant-General von Grossmann.

1st Brigade.—Major-General von Pape, 41st regiment, 1st regiment, 1st Rifles.

2nd Brigade.—Major-General von Barnekow, 3rd regiment, 43rd regiment.

2nd Division.—Lieutenant-General von Clausewitz.

3rd Brigade.—Major-General von Malotki, 2 battalions 44th regiment, 4th regiment.

4th Brigade.—Major-General von Buddenbrock, 45th regiment, 2 battalions 5th regiment.

Reserve Cavalry.—Colonel von Bredow, 12th Lancers, 3rd Cuirassiers, 1 battery of Horse Artillery.

Reserve Artillery.—Colonel von Oertzen, 7 batteries of Field Artillery.

Attached to the Divisions.—Eight batteries of Field Artillery, 1st battalion of Engineers, 2nd Hussars, 1st Dragoons, 8th Lancers.

Fifth Army Corps.—General von Steinmetz.

9th Division.—Major-General von Löwenfeld.

17th Brigade.—Colonel von Below, 37th regiment, 58th regiment.

18th Brigade.—Major-General von Horn, 1 battalion 5th rifles, 7th regiment.

Combined Cavalry Brigade.—Major-General von Wnuck, 1st Lancers, 4th Dragoons.

10th Division.—Lieutenant-General von Kirchbach.

19th Brigade.—Major-General von Tiedemann, 6th regiment, 46th regiment.

Reserve Artillery of the First Army.—Major-General Schwarz, 8 batteries of the 3rd, and 8 of the 4th Army Corps.

Elbe Army.—General Herwarth von Bittenfeld.

Advanced Guard.—Major-General von Schoeler commanding 31st brigade, 1 battalion each of 17th, 28th, 33rd, 40th, 56th, and 69th regiments, the 8th Rifles, two batteries of Field Artillery, and a company of Engineers.

Cavalry Brigade.—Major-General Count von der Goltz, 11th Hussars, 7th Hussars, 1 battery of Horse Artillery.

14th Division.—Lieutenant-General Count Münster Meinhövel.

27th Brigade.—Major-General von Schwarzkoppen, 16th regiment, 2 battalions 56th regiment, 7th Rifles.

28th Brigade.—Major-General von Hiller, 2 battalions 57th, 2 battalions 17th regiment.

15th Division.—Lieutenant-General von Canstein.

29th Brigade.—Major-General von Stückradt, 2 battalions 40th, 2 battalions 65th regiment.

30th Brigade.—Major-General von Glasenapp, 68th regiment, 2 battalions, 28th regiment.

Reserve Cavalry Brigade.—Major-General von Kotze, 8th Cuirassiers, Pommeranian Landwehr Cavalry.

Combined Reserve Artillery.—6 batteries of the 7th, and 6 of the 8th Army Corps.

Attached to Divisions.—5th Lancers, 7th Dragoons, six batteries of the 7th and 8th Field Artillery regiments, two companies of Engineers.

As covering force to the Reserve Artillery.—1 battalion, 57th regiment.

16th Division.—Lieutenant-General von Etzel.

Fusilier Brigade.—Colonel von Wegerer, 2 battalions 33rd regiment, 34th regiment.

31st Infantry Brigade.—Colonel Schuler von Senden (temporary). 29th regiment, 2 battalions 69th regiment.

Attached to Division.—7th Lancers, 3 batteries of the 8th field artillery regiment, 1 company of the 8th Engineers.

Infantry Division of Landwehr of the Guard.—Major-General von Rosenberg, 4 regiments ($11\frac{1}{2}$ battalions), 1 cavalry regiment, 2 reserve batteries.

Second Army.—Commanding-in-Chief, H.R.H. the Crown Prince of Prussia.

Corps of the Guard.—H.R.H. General Prince Augustus of Würtemberg.

1st Guard Division.—Lieutenant-General Hiller von Gaertringen.

Advanced Guard.—Major-General von Alvensleben.

2nd Guard Brigade.—Colonel von Pape, 2 companies rifles of the Guard, 2 battalions 2nd Foot Guards, 2 battalions Fusilier Guards, 2 squadrons Hussars of the Guard, 2 batteries of Field Artillery.

1st Guard Brigade.—Colonel Knappe von Knappstädt, 2 battalions 3rd Foot Guards, 2 battalions 1st Foot Guards.

Fusilier Brigade.—Colonel von Kessel, 1 battalion 2nd Foot Guards, 1 battalion 1st Foot Guards, 1 battalion Fusilier Guards, 2 squadrons Hussars of the Guard, 2 companies Rifles of the Guard, 2 batteries of Field Artillery.

2nd Division of the Guard.—Lieutenant-General von Plonski.

Advanced Guard.—Colonel von Pritzelwitz, battalion of Sharpshooters of the Guard, Fusilier Battalion of the Regiment Emperor Francis, Fusilier Battalion of the Regiment Emperor Alexander, 3rd Regiment Lancers of the Guard, 1 battery of field artillery, 1 company of Engineers of the Guard.

3rd Brigade of the Guard.—Major-General von Budritzki, 2 battalions Emperor Alexander, the regiment of the Queen Elizabeth, 1 battery of Field Artillery.

4th Brigade of the Guard.—Major-General von Loën, the regiment of the Queen, 2 battalions Emperor Francis, 2 batteries of Field Artillery.

Reserve Cavalry.—1st Heavy Cavalry Brigade, H.R.H. Prince Albrecht (son) of Prussia, regiment of Garde du Corps, regiment of Cuirassiers of the Guard, 1 battery of Horse Artillery.

Reserve Artillery.—Colonel Kraft Prince of Hohenlohe Ingelfingen, 5 batteries of Field Artillery of the Guard.

First Army Corps.—General von Bonin.

1st Division.—Lieutenant-General von Grossmann.

1st Brigade.—Major-General von Pape, 41st regiment, 1st regiment, 1st Rifles.

2nd Brigade.—Major-General von Barnekow, 3rd regiment, 43rd regiment.

2nd Division.—Lieutenant-General von Clausewitz.

3rd Brigade.—Major-General von Malotki, 2 battalions 44th regiment, 4th regiment.

4th Brigade.—Major-General von Buddenbrock, 45th regiment, 2 battalions 5th regiment.

Reserve Cavalry.—Colonel von Bredow, 12th Lancers, 3rd Cuirassiers, 1 battery of Horse Artillery.

Reserve Artillery.—Colonel von Oertzen, 7 batteries of Field Artillery.

Attached to the Divisions.—Eight batteries of Field Artillery, 1st battalion of Engineers, 2nd Hussars, 1st Dragoons, 8th Lancers.

Fifth Army Corps.—General von Steinmetz.

9th Division.—Major-General von Löwenfeld.

17th Brigade.—Colonel von Below, 37th regiment, 58th regiment.

18th Brigade.—Major-General von Horn, 1 battalion 5th rifles, 7th regiment.

Combined Cavalry Brigade.—Major-General von Wnuck, 1st Lancers, 4th Dragoons.

10th Division.—Lieutenant-General von Kirchbach.

19th Brigade.—Major-General von Tiedemann, 6th regiment, 46th regiment.

20th Brigade.—Major-General Wittick, 47th regiment, 52nd regiment.

Attached to Divisions.—8 batteries of Field Artillery, Regiment No. 5, two batteries of Horse Artillery.

Reserve Artillery.—Colonel von Kameke, 5 batteries of Field and Horse Artillery.

6th Army Corps.—General von Mutius.

11th Division.—Lieutenant-General von Zastrow.

21st Brigade.—Major-General von Hanenfeldt, 10th regiment, 50th regiment.

22nd Brigade.—Major-General von Hoffmann, 38th regiment, 51st regiment.

Combined Cavalry Brigade.—Lieutenant-Colonel von Wichmann, 4th Hussars, 8th Dragoons.

12th Division.—Lieutenant-General von Prondzynski, 1 battalion 22nd regiment, 23rd regiment, 6th rifles, 6th Hussars, two companies of the 6th Engineers.

Reserve Artillery.—Colonel von Scherbening, 4 batteries Field and Horse Artillery of Regiment No. 6.

Attached to Divisions.—6 batteries of Field Artillery Regiment No. 6.

Cavalry Division of the Second Army.—Major-General von Hartmann.

First Brigade.—Major-General von Witzleben, 2nd Hussars, 10th Lancers.

Cuirassier Brigade.—Major-General von Borstell, 1st Cuirassiers, 5th Cuirassiers.

Landwehr Brigade.—Colonel von Frankenberg, 1st Landwehr Lancers, 2nd Landwehr Hussars, two batteries of Horse Artillery.

RECAPITULATION.

	Battalions.	Rifles.	Squadrons.	Batteries.	Engineer Companies.
1st and Elbe Army..	100¾	5	103	74	10
Second Army	80½	5	81	56	9
Total	181¼	10	184	130	19
Landwehr Division of the Guard.	11½	..	3	2	..

Evening Meeting.

· Monday, June 29th, 1868.

VICE-ADMIRAL SIR HENRY J. CODRINGTON, K.C.B., in the Chair.

NAMES of MEMBERS who joined the Institution between the 15th and 29th June, 1868.

LIFE.

Donavan, E. W., Colonel, h.-p., late 100th Regt. 9*l*.
Radcliffe, W. P., C.B., Colonel h.-p., late 20th Regt. 9*l*.

ANNUAL.

Innes, Alex., Maj. Aberdeen Art. Vols. 1*l*.
Baring, J. D'Oyly, Lt.-Col. 107th Rgt. 1*l*.
Burlton, C. E., Lieut. R.N. 1*l*.
Jones, Jenkin, Lieut.-Col. R.E. 1*l*.
Mallet, Harold E., Capt. 18th Huss. 1*l*.
May, John, Lieut. Hants Mil. 1*l*.
Tombs, Sir Henry, K.C.B., V.C., Major-Gen. Royal Artillery. 1*l*.
Burnell, D. O., Major 16th Lancers. 1*l*.
Poole, W. Stewart, Lieut. Royal Art.
Massy, H. H., M.D., Dep. Inspector of Hospitals.

NAVAL TACTICS, WITH SOME REMARKS ON THE RECENT EXPERIMENTAL CRUISING OF THE MEDITERRANEAN AND CHANNEL SQUADRONS.

By Captain E. A. INGLEFIELD, R.N., F.R.S.

IT was at the request of one of the members of the Council of this Institution, that I was originally induced to prepare a paper upon Naval Tactics, and now on the invitation of that body, have come here to read it to the meeting this evening. Let me add that I did not arrive at this conclusion without some hesitation, partly from a sense of my own inability to do justice to the subject, and partly because I felt that the only grounds upon which I could presume to place myself before you to discuss the doctrines (if I may use such a term) of "naval tactics," must be based upon the experiences I had gained as a leader of the lee line during several cruizes with the Mediterranean and Channel squadrons, and I thought that these experiences were not to be dealt with as my own property, but rather as matter at the disposal of my Lords

Commissioners of the Admiralty. A reference, however, to their Lordships set my mind at rest upon this latter point, as they were pleased to consider that some remarks upon the manœuvres carried out under the old *régime* by the Mediterranean squadron, and under the present system by the Channel squadron, might prove beneficial to the service, inasmuch as that these experiences could, through the medium of a paper read in this Institution, be imparted to such of my brother Officers on half-pay as were desirous of profiting by them, and thus afford the means of comparing the merits of the two systems.

I am aware that an able paper on "fleet manœuvring" was read here by Commander Pellew so lately as May of last year, and since then, that he has published, under the same title, a work which deserves to be commended. Now I do not propose to discuss the various points he raises in that publication, nor do I wish that the few remarks I have to make upon Naval Tactics should be considered as a proposition for setting aside his or any other scheme. I shall rather confine myself as nearly as possible to a statement of a few of the principles, upon which it appears to me, should be founded the fundamental rules for the governance of a fleet at sea, and in a general way remark upon the experimental cruizing of the squadrons to which I have made allusion.

The science of "Naval Tactics"—and I do not speak unadvisedly when I use the word "science"—is one which, perhaps now, more than ever, demands the serious study of all naval Officers, but more especially those who, from their position in the service, have a fair expectation of command, either in single ships, or with a squadron, independently or in supreme command. Formerly our great sea fights were won as much through the skill and good *seamanship* of the Naval Commanders as by the energy and daring of those who followed their fortunes, and fought under their auspices.

When two hostile fleets met on the open sea, the "weather gauge" was—in those days—the great consideration, and the significance which a prize fighter puts upon the chances which give him the title to have the sun at his back, might not be inaptly compared to that which, by the chapter of accidents, gave the weather guage to the one of these fleets when first sighting each other. The skilful boxer who has lost the right of selecting his side of the ring, seizes every opportunity of bettering his position during the fight; and so when in former days it chanced that the Commander of a British fleet found himself to leeward of his enemy, by skill in manœuvring he was often enabled to gain the weather guage, which afforded the choice of battle, and to use the words of a great sea captain, "thus to earn for himself the first half of the fight." Now alas! our superior seamanship, and the sailing qualities of our vessels are of small avail. No longer would it be an important question (except in stormy weather, off a lee shore) as to which bearing with regard to the wind, the enemy might happen to appear.

Powerful engines, ever ready to urge the mighty battle ships hither and thither, utterly regardless of winds and tides, are to be found as perfect in form and action, and as well protected from the devastating

shell on board the war ships of nearly every European power, as in our own. Nay, do not even the puny States on the South American continent issue their orders, regardless of cost, to our private ship-yards, and not unfrequently do our public journals draw an invidious comparison between the magnificent iron-clad, with all the latest improvements, which has been launched from one of these yards for some foreign potentate, with the inferior vessel built for our own Government, at perhaps the same cost, but still an unequal match for the foreign giant, and thus is set at nought one of those qualities, *superior seamanship*, which in the British sailor has gone so far to make him the best of his class in all the world. It is thus because our ships are no longer so superior to those of all other nations—as was their wont to be in former times—that England loses much of her naval prestige amongst the nations of the earth.

With these thoughts, which have been confirmed by the opportunity that has been afforded me during my late service in the Mediterranean, of observing the armour-clad ships of other nations, I would urge upon my brother Officers who are younger, and have had less experience, the necessity for making the study of *naval tactics* one of the most important branches of their education; to do so successfully they must not *shy* at the term I have used, for it must be treated as a *study*.

There are several points which should be regarded as the leading principles upon which a fleet must *always* be managed, and under the comprehensive title of "naval tactics," must be understood the management of a fleet under sail, as well as steam, the former truly being now almost obsolete, except as an exercise, for no Commander-in-Chief now-a-days would think of manœuvring a fleet in the presence of an enemy under any other conditions but with a full head of steam; nevertheless if the principles of steam manœuvring are made the first consideration, the management of a squadron under sail will not be found a difficult task.

Before I allude more particularly to the formation for battle of a fleet, I must say a few words upon the subject of the position of the Commander-in-Chief of the squadron.

In practice, I have remarked the great difficulty which happens at certain times, and during certain evolutions, of the Commander-in-Chief *properly observing*, and therefore *certainly directing* all the vessels of his squadron. For example, should the Admiral desire to place himself in the van of his line, and that should happen to be a long one, he cannot possibly remark whether the ships are kept at proper distances; and only with difficulty, if any casualty should occur, or any signal be made, owing to the smoke, not only from his own funnel, but from those of the ships of his squadron, which combined tends so to obscure the vision (especially when the wind is right ahead or right aft), that it becomes almost impossible for him to descry the exact position of any of the ships, but those in his immediate proximity. Another, and perhaps more important point is the difficulty experienced by the ships of the squadron in making out the Admiral's signals, for it can only be by a repetition from the ships nearest to him that the

rearmost ship can become acquainted with his orders. This difficulty will be much increased in action when the smoke from the guns will render obscurity still more obscure, and it will apply equally to the Admiral's position when the column is reversed, an evolution which is often performed both under the old and new form of steam tactics, and whereby the Admiral's would become the rearmost ship of the fleet. I know I shall be met by the rejoinder that this is not a common occurrence, and that the Admiral *might* place himself in the centre of the line; but British Admirals are wont to lead the Van, and in case of a retreat to take the Sternmost position. I believe I am not singular in offering an opinion, that if the Commander-in-Chief could form and manœuvre his fleet from a vessel *not in line of battle*, he would do so with much greater convenience to himself and benefit to the service upon which he may be employed. However, whether this should ever become the prescribed position for the Admiral or not, it is unnecessary now to consider, and it does not in either case interfere with the general formation for fleet manœuvres, for the ship spoken of as *the* flag ship during all evolutions would be the vessel of either the Commander-in-Chief, or the Second in Command leading in line of battle.

Here I must touch upon a point which experience again has forced upon my notice. It is customary to place all the ships of a fleet in order of battle according to the seniority of their respective captains. At first sight it would seem a delicate task for a Commander-in-Chief to interfere with the prerogative of his Second to lead the lee line, or to direct the third senior Officer to place himself as a rearmost ship, but the necessities of the service (which will doubtless be the first consideration of a good Officer) require that the ships of the fleet on active service should be placed with due regard to their qualities for speed, weight of armament, and that *spécialité*, which, being of such recent introduction, requires more immediate attention, viz., the ramming properties of some of our modern vessels of war. Doubtless the Commander-in-chief's vessel would be the most powerful, both as regarded speed and armament. She might or might not be fitted as a ram.

Unless there was something which rendered the vessel of the Second in Command very unfit for a leader of the lee line, it would certainly be most advantageous that she should assume the post to which the rank of that Officer entitled him; but for the rest of the fleet it appears to me that each ship should be placed according to her qualities for speed *first*, for armament in the *second* place, and *thirdly* in consideration of her properties as a ram: and here it may be well to remark, that the rams of a fleet might be advantageously placed as the rearmost vessels of each line, when advancing in two or three columns. I believe it has been suggested to make up the rear squadron, or third division, entirely of rams, and perhaps, when it was practicable, it would be useful to make this rear squadron a squadron of reserve, to be employed like a column of reserve, in military warfare; then, perhaps, the rams might be brigaded together; but I think under ordinary conditions, these rams would be better placed as the rearmost ships in each division, for believing how difficult at all times it will be found to ram a ship which

is in full possession of all her motive power, I conceive that a ram would find herself in better position for that special service if called into action when the first shock of battle had partially crippled, or at least paralysed the foe.

I have suggested that the ships should be placed in line of battle, more with reference to the qualities of the ships than with regard *to the seniority of the captains*. But there is another point which appears to deserve consideration, I mean the homogeneity, or rather the want of homogeneity in the speed of vessels of our present day squadrons.

It will easily be understood by Naval Officers that this want would be seriously felt by a Commander-in-Chief desirous of pursuing an enemy's fleet at his utmost speed.

Now, as an example, let us take the 8 hours full speed trial of the Channel Squadron off Lisbon last autumn; then the "Achilles" distanced the rest of the fleet, and had she been in pursuit of a flying enemy, would have brought them to action, unsupported by a single other vessel of the squadron.

This want of homogeniety (I can find no better term to signify my meaning) is fully appreciated by the French, who for the most part fit their ships with engines of sufficient power to ensure a minimum speed greater than the average speed of a corresponding number of our vessels of war.

To meet this want, some interesting experiments in towing were instituted by the Commander-in-Chief (Lord Clarence Paget) in the Mediterranean squadron, whilst I was serving under his orders, and I have here the tabulated form of these results. By them it will be seen that his object was to establish the fact as to the power at his disposal to bring all his squadron to a given point in the shortest space of time. This experiment was made by a comparison between the speeds obtained whilst the ships were under tow of each other, and it was based upon the consideration that thus all the ships would be brought into action together, by reducing the speed of the fastest, and increasing that of the slowest vessel in the squadron. To quote the words of Lord Clarence Paget, who says,—"Our towing trials may be shortly "stated to have resulted in a homogeneous speed of various ships, all "under steam, tied together, at something less than the mean of their "united individual speeds, and at an expenditure of coals of about the "same ratio. The only possible disadvantage was the risk attending "the operation, which I hold to be comparatively *nil*, since, if the lead-"ing ship suddenly broke down, her momentum would be sufficient to "sheer her clear of the others, cutting of course the hawsers. How-"ever, risk or no risk, it would, on certain occasions, when it was an "object to bring our *whole* force to a point in the smallest possible "time, be a great gain."

It will be remarked by a reference to the table, that the towing experiments, which lasted an hour each time, were made under certain disadvantages, the rear ship in each division, viz., the "Cruizer" in the weather line, showing a very low indicated horse-power, not more than one-half of that which the boilers were capable of developing, and the "Enterprise" in the lee line requiring a high power to tow her, for

though the engines worked satisfactorily, when the trial had ceased, she had not developed the full energy of her boilers.

Now, supposing the power to vary as the cube of the speed, and *vice versâ*, it will be seen that :—

Ships' Names.	Indicated Horse Power required to propel the same vessel separately at the speed given by log.	Power expended in towing.	Speed due to Horse Power as compared with 5th trial.	Time it would occupy to steam the ships 100 knots.
Victoria	2687 ·3	1003 ·5	11 ·67	h. m. 9 32
Gibraltar.............	2570 ·0	56 ·5	10 ·576	
Cruiser	727 ·5	..	5 ·177 compared with trial trip	
Total	5984 ·8			
Prince Consort	2612 ·1	1526 ·0	12 ·22	9 32
Royal Oak	3266 ·9	Nil	10 ·5	
Enterprise	1130 ·0	..	8 ·091	
	7009 ·0			

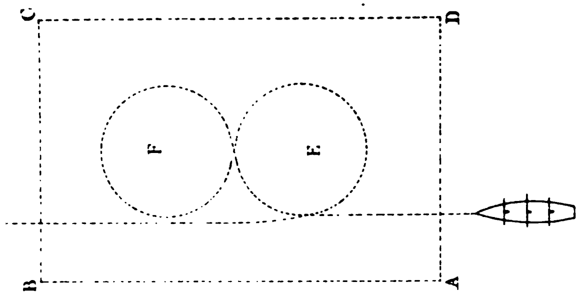
The fifth trial alluded to, was one of full speeds, independently as a standard for comparison.

By the above it will be seen that the "Victoria" at full speed, not towing, would steam 100 knots in 50 minutes less time; "Gibraltar," 100 knots in 14 minutes less time; "Cruiser," 100 knots in 6 hours 28 minutes more time; expenditure of coal about the same. "Prince Consort," 100 knots in 1 hour 12 minutes less time; "Royal Oak," 100 knots in the same time as when in tow. "Enterprise," 100 knots in 2 hours 49 minutes more time; expenditure of coal about 10 tons less, by towing.

This table may prove interesting, because, as far as I know, these towing trials are novel as regards the intention for which they were instituted; and we may glean from their results the facts which have been summed up in the words, before quoted, of Lord Clarence Paget, than whom no Officer could have shown a more anxious desire, not only to instruct all those under his orders, but to learn by experiment himself, *in every possible way, and under every possible condition*, the fighting, steaming, and sailing qualities of the ships under his command.

The New Signal Code for the management of a steam fleet appears to me such a decided improvement upon the old one, that I am satisfied that nearly all the requirements of an Admiral in the management of

Fig 2.



TACTIC BOARD.

Fig 3.

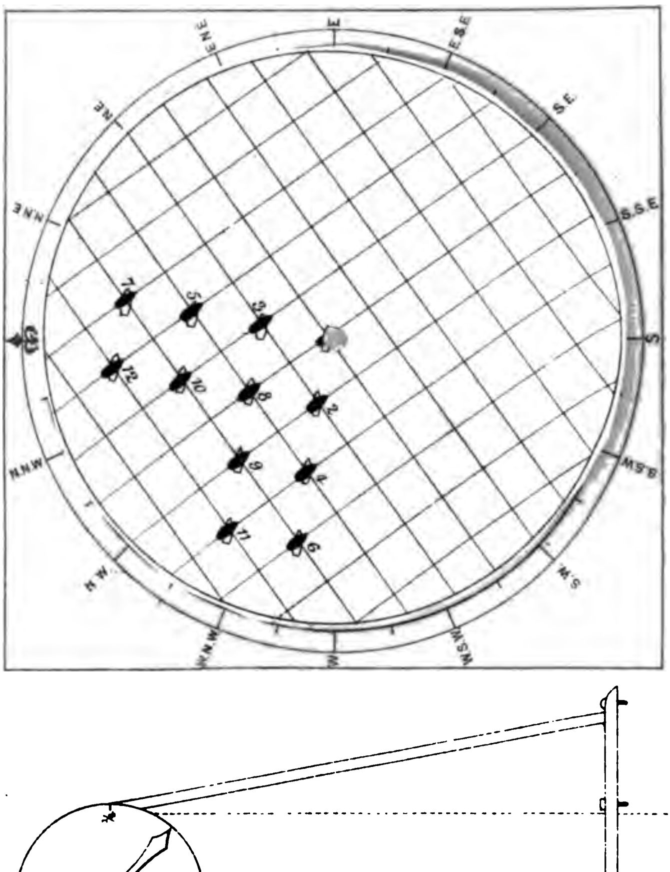
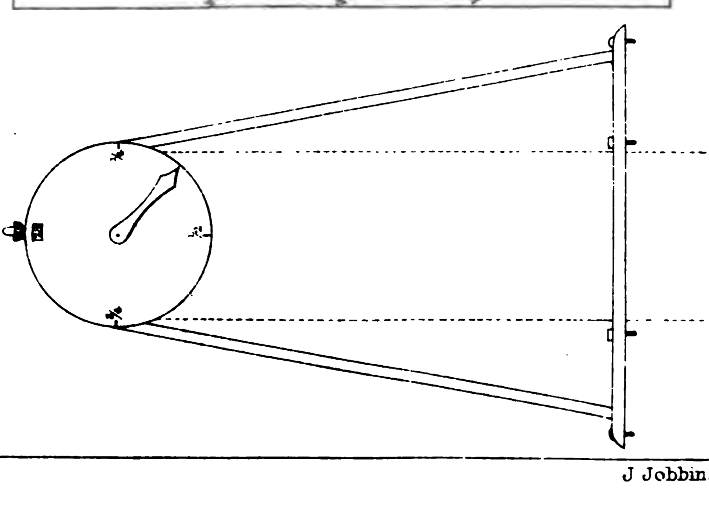


Fig 1.



J Jobbins

squadrons have been met; and great credit is due to those who, with so much skill and patience, have digested the scheme, and so ably exemplified their labours. The Service is greatly indebted to Admiral Sir William Martin for the numerous observations he has published on Steam Tactics; these have been well supplemented by Admiral Sir Sydney Dacres, and are now compiled by Captains Colomb and Brent with simplicity and facility of reference, reflecting great credit upon these gentlemen. After these remarks, it is needless to add further comments on the value to my mind of the code of signals now employed in the New Signal-Book, excepting where I am desirous of remarking upon or comparing such isolated cases as are necessary to my purpose, and of these I am only permitted to speak in general terms, as the publication of signals or matter collected from the signal-books is prohibited by their Lordships. I leave the details therefore of the mechanical process by which the Admiral's orders are conveyed to his Captains, and desire to draw attention and invite discussion upon the manner in which these orders should be carried out.

Referring once more to the want of homogeneity in our fleets, I may remark that another difficulty presents itself in the management of a squadron where the speeds attainable are so varied. With reference to the speed of the engines, the natural method of meeting this disproportion in their speed value is by a process of tabulating the screw revolutions of each ship in the squadron as compared with their speed, and then assimilating them to each other, or otherwise by dividing the speeds into, say, three denominations, viz., full, half, and slow speed, and then fixing for each ship the number of revolutions necessary to maintain her progress at either of these speeds as established by the Admiral in rates of knots. Thus let it be supposed that the Admiral determines that full speed shall be 11 knots, half speed, 6 knots, and slow speed, 4 knots, and that whilst the flag-ship's number of revolutions to attain these three speeds were, say, 60 for 11 knots, 25 for 6 knots, and 10 for 4 knots, that of his next in command, 56 for 11 knots, 22 for 6 knots, 9 for 4 knots. Then, whenever the Commander-in-Chief made the signal "full speed," his second would cause the engines of his vessel to be put to 56 revolutions, and each ship of the squadron knowing the relative value of revolutions with regard to speed (in their individual vessels) would give the necessary instructions.

I found that orders were frequently imperfectly conveyed through the speaking tube to the engineer, the method of speaking through this tube being so different; and once on board the "Prince Consort," owing to the engineer of the watch misunderstanding the order of 28 revolutions for 38, we narrowly escaped a collision with the next ship, steaming, as was the custom of our Commander-in-Chief in the Mediterranean, continually in close order. To prevent the probability of a similar occurrence, I constructed a *revolution indicator*, of which I show here a rough figure (Plate xxii, fig. 1). It was placed over the engine-room hatch between the boom-boats, so that the face and back could be observed from the after and fore bridges. This indicator consisted of a circular box placed in a vertical position, and supported by suitable legs. The front and back of this box had apertures, through which

could be seen the figures marked upon the edge of a revolving disc inside, and which exactly corresponded with a similar instrument placed in the engine-room immediately facing the engineer on duty. These graduated discs were connected by an endless chain, which necessitated their working in unison, and thus there was constantly presented to the eye of the Officer on deck, and to him in the engine-room, a distinct signal, showing the number of revolutions at which the engines were working. The Officer in command could impart his instructions to the engine-room by means of a small handle, causing the wheel to revolve within its case, and a boy would be stationed to attend to this duty. By such an arrangement, no mistake could possibly occur unless the instrument were out of order, and its simplicity of construction (ours was made by the ship's joiner) rendered that contingency unlikely. Of course this instrument would tend to assist the regulation of the speed cones by day, and of the lanterns at night, hoisted at the yard-arms to indicate the number of revolutions at which the engines of individual ships were moving.

And here I must not pass over another feature in the management of the ships of the squadron, which deserves careful consideration. A great disproportion existing between the length of the ships which may be in line, as well as the angle at which the tillers can be put over, it follows, that if at a given speed the Admiral made the signal to alter course *simultaneously* 16 points, and each vessel were to put her helm hard over, on the signal being hauled down aboard the flag-ship, it would result in the whole squadron being thrown into confusion, and possibly cause some collisions, no two vessels turning within the same radius. Now, to prevent such an occurrence, it is desirable that upon a fleet being first formed, each ship should be required to supply to the Commander-in-Chief, a table, showing the radius at which she can complete the circle at full, half, and slow speed, and the angle at which she can put over her tiller.

Most ships, perchance from something in their build, and owing to the peculiar action of the water thrown from the screw on the rudder, turn in a smaller circle when the helm is put a-port, than when put a-starboard, thus the "Prince Consort," with the helm hard a-port, angle of rudder being 23 degrees, took 4 minutes and 56 seconds in turning a complete circle at full speed, while with the helm hard a-starboard, angle of the rudder 24 degrees, it required 5 minutes and 20 seconds to complete the full circle. It is clear, then, that to manœuvre a squadron with certainty and precision, it is desirable that vessels composing that squadron should be homogeneous in this respect. As a general rule, subject to variation of wind and sea, it is found that at a given speed, the less amount of helm given, the greater will be the diameter of the circle described, and the longer the time occupied, and also that with a given helm angle, the less the speed used, so much the less will be the diameter of the circle described, and so much longer the time of turning.

Lord Clarence Paget required that the vessels of his squadron should on convenient occasions perform a figure of 8 evolution. This was

done by placing buoys, as shown in the diagram (Plate xxii, fig. 2), and which may be briefly explained thus :—

A, B, C, D, are four buoys placed in the form of a parallelogram, of which the long side will be approximately $4\frac{1}{2}$ times, and the short side, three times the length of the ship.

E, F are two buoys placed one length and a half of the ship apart, and at even distances from the centre of the parallelogram. The ship is to enter the parallelogram, either between B and D, or between A and C, the exact line of her stern passing the dotted line between the two buoys being noted, she is then to perform a figure of 8 within the parallelogram by crossing, each time between the points E and F, as shown in the diagram, and she will then come out at the opposite end of the parallelogram from that at which she entered, the precise moment of her stern passing between the buoys on leaving the parallelogram, being also noted.

No ship is to use more than half boiler power, but she may aid herself in any manner by the use of sails or otherwise, as may be deemed expedient.

When once the ship is within the parallelogram, if any part of her should touch the dotted straight lines between the buoys, she will be supposed to have grounded, or should she touch either of the buoys, E F, she will be supposed to have fouled the ships which they are intended to represent. In either of these cases the manœuvre must be presumed to have failed. The direction and force of the wind, the state of the sea, and the direction and strength of the current (if any) are to be noted during the experiment. This exercise had the effect of teaching the Officers what were the steering capabilities of their ships, not only whilst going a-head, but when moving astern; and I may add that after we had made the experiment twice, in which I am bound to say we did not quite succeed, I had much greater confidence in managing the vessel when moving in and out of confined harbours, or in close order with the squadron. Such practice as this must prove useful, and cannot fail to instil valuable instruction regarding the steering properties of a vessel, not only for the benefit of her commander, but also of the lieutenants and master.

If in case of war, the old fashion of carrying different coloured ensigns to distinguish the three divisions in a Fleet were again adopted, some advantage might be derived. This will be partially met by having vanes of different colours at the mastheads of the ships, and if I remember rightly, this has been proposed by the compilers of the new signal books.

I now come to the formation and arrangement of a Fleet. When ships meet with a view to their being "brigaded" together, the first duty of the Commander-in-Chief must necessarily be to divide and subdivide the Fleet as a body, into divisions and subdivisions, this arrangement and these terms being now-a-days considered more suitable than those formerly employed of *van*, *centre*, and *rear* squadrons. The Fleet may be divided according to its numbers into one, two, three, or four divisions, and these divisions may be again subdivided, and proper

distinguishing flags and pendants assigned to each. There will also be a number given to each ship, which is called her *Fleet number.*

Now this Fleet number will be found useful, not only whilst referring to the diagram, but when the Commander-in-Chief should desire to alter the position of any two ships in his squadron, then it will only be necessary to desire that these ships should change their Fleet numbers, and the Captain of each will immediately understand (by reference to a diagram), her division, sub-division, and the post she will have to fill in each manœuvre. To exemplify the formations of a Fleet, I have made the diagrams shown on this sheet (Plate xxiii).

Fig. 1, column in line a-head.

Fig. 2, columns of division.

Fig. 3, columns of subdivision.

Fig. 4, columns in line abreast (single column).

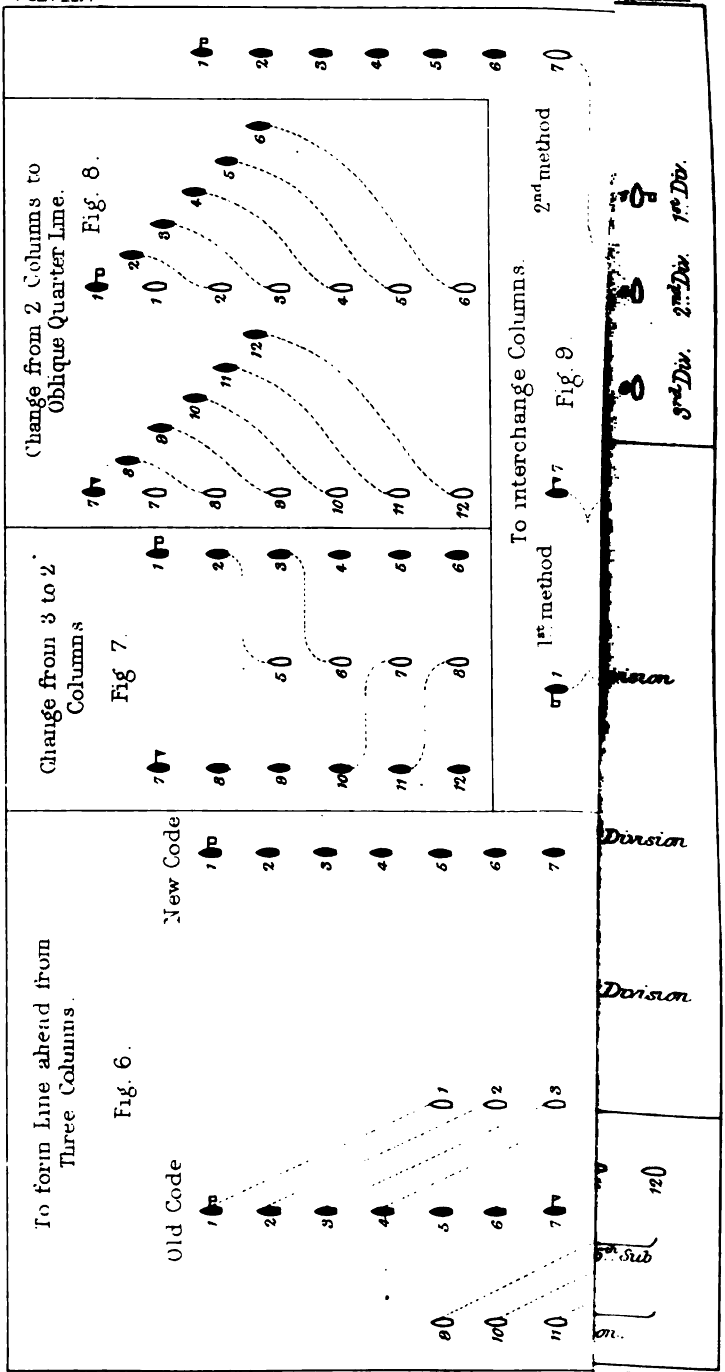
Fig. 5, columns of divisions sailing in lines of bearings.

These show what positions ships and columns should take up when *forming in orders. Close order* means two cables apart from mainmast to mainmast; *open order*, four cables apart. Columns twice as many cables apart as there are ships in the longest column, but never less than six cables. Each cable is supposed to be 100 fathoms. It is the rapid and certain change from one order to another, or into variations of these orders, which constitutes the skilful manœuvring of a squadron.

These evolutions may be classed under seven heads, viz., first, when the Fleet or squadron, after being becalmed, lying too, assembling, or otherwise situated,—is so as to be at the moment in no distinct formation. This class of evolutions comes under the head of "*forming orders;*" the second of "*changing formations;*" the third of "*changing direction of columns;*" the fourth of "*changing the course of the Fleet;*" the fifth of "*altering course*" only; the sixth of "*opening and closing, and stationing;*" and seventh, and lastly, a class of signals to comprehend "*miscellaneous evolutions.*"

Most of these would apply to manœuvres under sail, but there are supplementary evolutionary signals which specially apply to squadrons under sail. Now as it would be unadvisable, and is perhaps unnecessary, to enter more at large upon these various kind of evolutions, than by some examples in a few cases, I will confine myself to suppositionary evolutions. First, the line a-head in single column, which is the most convenient and usual form for proceeding out of port, and which Admiral Warden always adopted when taking the Channel squadron out of the Tagus.

Let us suppose that he desired to alter his formation into a line abreast, continuing on the same course: this would naturally be carried out by the ships astern steaming up at full speed to form on either or both sides of their leader, according to signal; then should he desire to form from line abreast to single column in line ahead, and at the same time to alter the course of the squadron 8 points, either starboard or port, this evolution would be readily carried out by the Admiral making a signal to alter course simultaneously 8 points to starboard or port


To form Line ahead from Three Columns.
Fig. 6.
Old Code
New Code
Change from 3 to 2 Columns
Fig 7.
Change from 2 Columns to Oblique Quarter Line.
Fig. 8.
To interchange Columns.
1st method
2nd method
Fig. 9.
3rd Div.
2nd Div.
1st Div.
Division
Division
5th Sub

J Jobbins

However, this would necessitate in one case an alteration of the Admiral's position to the rear of his squadron, instead of the van, and to regain his post without altering the direction in which the ships were moving, he would hoist the signal to reverse the line and thus complete the manœuvre. There would be variations of this first formation in line abreast of single column, with regard to the position of divisions a-head or astern of the Admiral, or with the Admiral in the centre, and the same will refer to columns of divisions, whether two, three, or four, both in line abreast and in line a-head; also in columns of subdivisions; but in all these formations the fleet numbers must be carefully considered with reference to the positions the ships are to assume. There is another consideration which must enter into the formation of a squadron when under sail, and that is the line of bearing. The signal for this evolution will be understood to mean that ships are to place themselves with respect to one another on that compass bearing on which they would sail when close to the wind, on either tack in formation ahead (see Plate xxiii, fig. 5).

It must always be borne in mind that bearings and distances of ships in columns are to be taken from the leader when in line a-head. Starboard wing ship when in line abreast, from the most advanced ship when in quarter line, from the ship at the angular point when in two bow or quarter lines, and from the weathermost leading ship when sailing on either starboard or port line of bearing.

The second class of evolutions which is changing from one formation to another, deserves our next consideration, and it is to these I would desire especially to draw attention.

The new code of evolutionary signals is based upon a principle analogous in some measure to that employed for the movements of bodies of men in the field; this has been not inaptly styled the rectangular principle, and thus nearly the whole of these evolutions are made by making one or two rectangular movements to change the formation, in other words, to alter course eight points to starboard, and then eight points to port, and *vice versâ*—of course by divisions or subdivisions in succession or simultaneously, according to the evolution required.

I will take an example to illustrate my meaning. The Admiral having come out of port in single column line ahead, desires immediately to alter this formation of his Fleet, from single line to columns of divisions in line abreast, by turning to port. The signal being hauled down (which is always the sign that the evolution is to be commenced) Fleet numbers Nos. 1, 4, 7, and 10, as shown in the diagram (Plate xxiii, fig. 1), will turn together eight points to port, followed in their wakes by the respective ships of their divisions—a particular flag which is always used upon these occasions by the leaders of divisions regulating the movements of their own divisions. When the whole Fleet is thus divided into four divisions, steering eight points to port of their original course,—but now in line abreast,—the whole of the ships return to their original course simultaneously, and thus the evolution is completed.

There was no evolution of this description in the old code of 1859

though, of course, such a formation as the above could have been made by a series of signals and corresponding movements.

Let me take another example, which will compare with the old system. In that code, when the Admiral desired to form single column in line a-head, ships being in line of bearing or in line abreast, and formed in three divisions or columns, (see Plate xxiii, fig. 5), Nos. 1, 5, 9, Fleet numbers leading; the centre continues its course at slow speed, or small sail; the starboard or first division would alter course by bearing up under steam or under all sail, to arrive ahead of the centre division, and the ships of the third division or rear squadron would tack if under sail or alter course under steam, so as to arrive in the wake of the centre squadron. Now let us take the new code (see Plate xxiii, fig. 6) and propose to perform the same evolution: the ships of starboard wing column, or first division, continue on their course, and those of the remaining columns of divisions turn together to starboard, and, *preserving their formation*, resume the original course, so as to arrive in the wake of the leading column.

I am not at liberty to make allusion, except in a general way, to the evolutionary signals or the forms by which they are carried out, but I will suppose one more case to illustrate how a change from three divisions or columns to two divisions would be effected.

In practice it is found more convenient to break up the second or centre division, and the evolution would be performed in this manner (see Plate xxiii, fig. 7):—The headmost ships, Fleet numbers 5 and 6, would turn eight points to starboard, and when arrived in the wake of the first division, would then resume their course by turning eight points to port. At the same time, numbers 7 and 8 would turn eight points to port, and when arrived in the wake of the third division, would turn eight points to starboard, and thus complete that evolution.

The whole of these evolutions being performed upon a principle which, if borne continually in mind, it will be found comparatively easy to determine at once what is necessary to effect any alteration in the formation of the Fleet the moment a signal is made.

The next class of signals under the head of "Changing Direction of Columns," allude especially to the bow and quarter line formation, which may be at the desire of the Commander-in-Chief, 4, 5, or any other number of points to suit his purpose, and one, two, or three divisions may be thus disposed, and these may be on the starboard or port quarter of leader, or the *whole* may be ordered to form on the bow and quarter of the leading ship (Plate xxiii, fig. 8). Another variation of the same form, and which has found some favour of late days, viz., *the wedge shape*, is readily produced by the signal to form starboard and port quarter lines on the leader.

If while the ships are in this position the Admiral desires to alter the course of his squadron eight points without altering their formation, he would make signal to that effect, and the evolution would be carried out by the leading ship altering her course the required number of points, and those on her two quarters gradually decreasing and increasing their speeds, so as to come to their required positions with as little delay as possible, but should he signalize that the course of the Fleet

was to be altered simultaneously eight points, you will observe that in this case the entire figure would be changed, and in practice I found that when this was tried, if even one ship got out of position, with regard to the rest of the squadron, it was very likely to throw the whole Fleet into confusion, particularly if in close order, and it was very puzzling to say where that ship ought to go, the appearance of their relative positions being so much altered.

To assist the Officers of the watches, and indeed myself in such cases as that suggested, I devised a tactic board, which I have brought here this evening, and a larger copy is exhibited to illustrate its uses. Let me refer to it for this example (Plate XXII, fig. 3):—Here is the position of the squadron in wedge shape formation—steering north: now the Admiral makes the signal, "alter course *in succession* eight points to starboard," by turning the centre-board eight points, the formation, it will be seen, is unaffected, and though the bearings from each other are altered in name, the *relative* bearings remain the same—the squadron steering east.

The signal now "to alter course, together or *simultaneously*, four points to port," changes the whole aspect of the squadron (see the light outline of ships in the figure), and if Fleet number 8 should get into difficulties, without reference to some such diagram-board as this, he is likely to hesitate as to his proper whereabouts, and in the mean time he might mislead others. Now I will suppose another change. "Alter course together ten points more to port," and now the variation is again easily adjusted by the reference to the board; "two points more to port" and the squadron is formed in the figure known amongst naval tacticians as "Cornwallis's retreat." Whilst upon the subject of this board I may say that all evolutions are very much assisted by a continual reference to the diagrams, which are altered on the board, the little cardboard vessels with fleet Nos. being fixed with pins, at each change of signal are shifted with facility, and it then becomes a guide to the Master or Officer in charge.

The lines crossing each other at right angles in the revolving centre-board are supposed to be at two or four cables apart, as most convenient.

On the margin of the square board are marked the compass points, and the blank space is filled up with a few maxims of moment.

The "course of the Fleet" may be altered, as shewn in the last figure, from one to sixteen points whilst retaining position; by due reference to bearings and distances, there are some refinements by which the new figure may be more rapidly attained, but which it is hardly necessary to allude to here.

All the usual signals for keeping in close or open order, nearing the Admiral or a particular ship, and in assigning or altering stations, are coded together, so little difficulty is experienced by him who directs or those who obey, in referring to the new signal books.

Amongst miscellaneous evolutions was one (often practised in the Mediterranean) for changing columns or divisions, whereby the starboard or weather column was made to become the port or lee column. This was effected by the leaders of each column, followed simultaneously

by the respective ships of their columns, putting their helms over at the same moment, so as to pass one another on their port sides, and having thus crossed each other at midway between their original distances, returning back to their first course, so as to assume the same distance of columns as that established before the evolution. (See Plate XXIII, fig. 9.)

Another mode of performing the same interchange of positions can be effected by one column going astern of the other, and when all are in line, then the other column would alter its course, and take up the position originally occupied by the first. When a squadron or fleet is formed in close order, and evolutions are being rapidly performed, any casualty to a single ship, either in her engine-room, or with her steering gear, may prove of great inconvenience, if not danger, to other ships, unless timely warning be given. Of course the Commander of such vessel would immediately communicate to the Commander-in-Chief by signal that he was disabled; this, however, would take some time, and vessels in the immediate vicinity would run some risk of collision. This sort of accident occurred once to the "Royal Oak," in the Mediterranean squadron, while we were in close order. Her tiller ropes carried away, she was at once unmanageable, and the ships in company wondered at her erratic motions.

Now I would suggest that it should be a standing order in a Fleet, that when anything of this sort took place, the ship thus disabled should immediately turn on her steam whistle, and keep it sounding as a warning to the rest of the squadron, until she was clear of all dangerous proximity.

Lord Clarence Paget was in the habit of assembling the Captains of his Squadron on board his Flag-ship before evolutions, and after they returned to port, and sometimes when the weather was suitable at sea, to receive suggestions from them, and remarks upon the exercises they had been performing. I think that considerable benefit to the service accrued from this interchange of experiences.

There was another custom in the Mediterranean squadron, instituted by the Commander-in-Chief, which, though it has nothing to do with "naval tactics" in the general acceptation of the term, I think may be quite worthy the imitation of others. On our days for shot practice at a target with great guns, a floating target used to be towed astern of the flagship at a convenient distance, and the ships of the squadron were directed to range up in succession at the number of yards indicated by signal, and thus deliver their fire at the mark. The Admiral could then observe from the poop of the ship the precision of firing from each vessel, a quick-sighted Officer noted every shot, and a table of the result was afterwards lithographed and circulated in the squadron.

In the Channel Fleet, Admiral Warden adopted a plan of exercising with the steam launches, a very useful and economical way of instructing the junior Officers in "naval tactics."

Should the opportunity ever occur for assembling a flotilla of gun-boats in the Channel for similar exercise, I believe much instruction might thereby be gained, and if Officers on half-pay might be allowed

to take that opportunity of "keeping pace with the times," there would be numbers who would doubtless gladly avail themselves of the occasion.

I fear I have extended my paper already beyond the usual limits of an evening reading, but I can hardly close without an allusion to that mode of fighting at sea which must be a very marked feature in all future naval engagements. It will be readily understood I allude to ramming an enemy. The preparation of a ship when going into battle with the view to receive or impart blows, would be the first consideration, and there would be the proper arrangement of top-gear and bowsprit. I cannot particularize these preparations without infringing on the matter contained in a confidential report, which, with other Captains of the Fleet, I was required to forward to their Lordships; but here will be more properly discussed, and I hope my brother Officers will offer opinions upon this matter, as to the best formation of a Fleet to receive the shock of an enemy's rams, or to act offensively in this fashion.

There is no signal or diagram which shows how a Fleet could be readily placed in the form which it occurs to me would be the best when not taking the initiative, but let us suppose the Fleet was formed in *two* columns or divisions in open order steering north, and on starboard line of bearing.

The enemy are seen coming down on the port beam. If the Admiral were to make the signal "alter course together, 8 points to port," the result would be a double line abreast, which in effect would appear like a single undulating or deeply serrated line, there would be a sufficient distance between the ships to admit of each vessel being steered so as to avoid the enemy's rams, and at the same time they would be in the best position when the shock was over for returning at once to their original course, and pouring a raking fire into the enemy's sterns. Again, if the British Admiral desires to take the initiative, then I should suggest the wedge formation in *three* or *four* divisions, according to the numbers in his Fleet, and I fancy this would prove the best form for dividing an enemy's squadron.

In closing these remarks upon "naval tactics" of the present day, I must again reiterate that I do not pretend to advance much that is original, but rather to quote experiences, and to invite discussions, the former not altogether without use, if only to give basis upon which argument may be encouraged and opinions elicited.

Commander Colomb, R.N.: I do not know that I can better sum up at the commencement of my remarks my impressions of the paper we have heard, than by saying that I believe Captain Inglefield has said nothing in which I do not thoroughly agree with him from first to last; therefore, as to offering any criticisms, I, of course, have none to offer. I agree with him in the remark he made at the commencement of his lecture, that Naval tactics are a *science* and must be made a *study*, and it must the more be made a *study*, because in the nature of things the practice we can get with ships at sea will be confined to a small number of Officers. On the outbreak of war, however, the whole Navy may be suddenly called on to deal with questions of large fleets, therefore, those Officers who have the leisure to do it, should make a study of the theory of the subject, in order to be ready when the time comes for the practice. I also quite agree with his remark, that in making steam the basis of your tactics, you should not omit the consideration of working your fleets under sail

on the same principle. As to the position of the Commander-in-Chief, I also again agree with him in thinking that the Commander-in-Chief must in these days be free from the trammels of keeping in a particular position; he must be allowed to take his position wherever he thinks proper, without running any danger whatever of throwing out the movements of the fleet, or being supposed to be the real point for concentration. With regard to the use of "rams," it is quite a sign of the times that since I had the honour of being the first (I think) to bring forward the subject in this lecture-room, some two and a half or three years ago, five or six Officers have spoken, just as strongly as Captain Inglefield has, in their favour. I have no doubt whatever in my own mind that the "ram" is to be the weapon of the future for naval attack and defence. The question is, whether the "ram" will be most efficient for opening up the attack, or, as the bayonet is on shore, for the finishing touch. I think, myself that the proper time to use the ram is at the commencement, because I look, not so much to the material effect of the ram, to the number of ships that may be destroyed by it, but to its moral effect—the amount of nerve-disturbance created in a fleet by the chance of being rammed; and I should wish to produce that nerve-disturbance as soon as possible. After the fleet is well engaged, it appears to me that the opportunity for ramming will not be great, because you must have speed to damage a ship seriously with the ram; and when the fleet is in the *melée*, any outside ship coming as a ram would have more or less difficulty in picking out, in the smoke, the object that she is going to attack. But at the commencement of the action, where half a dozen rams are despatched in front, of course they have nothing but the enemy before them; they cannot hit a friend, they have nothing to do but to go straight on. It has been a gratifying circumstance to me to hear Captain Inglefield speak in such favourable terms of the new signal books, I having had a little to do with them. Of course it was a labour of considerable difficulty, as every naval Officer will allow, and it is a satisfaction to know that Captain Inglefield's opinions are, I believe, generally held by those Officers who have had experience of them, and it will be gratifying to Sir Sydney Dacres to know that the course he recommended in reference to this troublesome question has resulted in a successful issue. I think the exercise with buoys—making ships turn in the figure 8—a first-rate arrangement. I do not know any other plan whereby a Captain could get sufficient knowledge of his ship's turning powers to the same extent as by this arrangement. Properly speaking you require for tactical purposes to work with other ships, and to compare your turning powers with theirs; and until you have thoroughly mastered the turning powers of your own ship *per se*, you are hardly in a proper position to determine her relative turning powers with those of the ships near.

I am sure all the members at this meeting must have been struck with the number of new terms that have been imported into the signal book. Captain Inglefield is evidently very familiar with them, but I am afraid many members who have not had the same experience, may have found a difficulty in following him; the fact is that the whole of the old terms have been at once swept away; it was found impossible to keep them. As regards the angular formation and the confusion which has been found to occur from one ship getting out of the formation, *that* was a point which we discussed at a former meeting, and we decided that the angular formation, for that reason, should not be assumed except with a squadron which was thoroughly trained in the use of it. It is doubtless a very good formation for some purposes, but it is extremely difficult to retain and to manœuvre in.

Captain Houston Stewart, R.N.: As Captain Inglefield wishes to invite discussion, I should like to get an opinion expressed as to this "ramming." We will suppose that in case of war the English fleet will not be composed of the same material as the fleet with which Lord Clarence Paget, with his well-known ability and zeal has attempted to carry out steam-tactics, because it is idle to talk of perfect steam-tactics with vessels of different powers, including the three-decker and the small corvette. But we will suppose that the ships which are going to receive these ram-attacks are ships of equal power and equal speed, and are as capable of as great speed as the fleet that is going to attack them. If it is the French Fleet, we know that every ship will be exactly alike, and that their speed will be the same, consequently the Captains of those vessels will have no difficulty in keeping their relative

positions in making the attack. We hope and expect that it will be the same with the English Fleet. One fleet comes down at 10 knots, and the other fleet goes at 10 knots. How is the fleet that is moving at 10 knots to ram the other fleet that is also moving at 10 knots? I do not understand it. I do not understand why I should be rammed if I am going 10 knots and the other man is coming down on me at 10 knots. The only two distinct cases of ramming that we know of between ships, were those of the "Merrimac" and the "Monitor," and the ramming of the "Tennessee" in the action off Mobile. In the latter case the ships rammed and retreated, and came on again, and we are told that the effect was to strike the men down at their guns, and the result was the capture of one of the vessels. Those were cases in which both parties wished and tried to be rammed. But I can hardly understand how two fleets composed of vessels of equal speed and equal material can begin an action by ramming one another. I have not clothed this in elegant language, but Captain Inglefield has expressed a wish that the question should be discussed. There is only one other remark I should like to make. Of course the two great elements of success in a steam navy are a well-considered and well-devised system of steam-tactics, and also that our fleets and squadrons should be composed of such material that they can work effectively under steam. That point does not rest with the Officers of the Navy, but with those who direct our councils. I hold that every Commander of a fleet, and every Captain of a single ship, if he possesses the signal book, has it in his power to bring himself, his Officers and his men into practical acquaintance with a universal system of steam-tactics in the Navy. Many of us remember the time when our Navy had no universal system of gunnery, when every ship in the Fleet had her own system of gunnery, and it was a question whether we should have a universal system of gunnery. That is all over now, every ship in the service has the same system of gunnery. And why should we not have a universal system of steam-tactics. We have our experimental squadrons; why cannot there be a day in the week when our Officers can be assembled in the cabin with the Captain and put through all the tactics, so that every Officer in the ship may learn every signal and every manœuvre? The thing is as simple as possible if we had a well-devised system of tactics. I hold it is a most important vital point, that every Officer in the Navy should be thoroughly instructed in the theory of steam-tactics; that must be the first thing.

Captain FREMANTLE, R.N.: In the presence of so many Officers of superior rank, who have had more experience in most matters connected with the service to which I have the honour to belong than myself, I feel some diffidence in asking any questions. But I should like Captain Inglefield, before he replies, to be kind enough to give us a little information on some subjects which I did not quite understand from his paper. In the first place, we know that there are new steam-tactics, to which Captain Inglefield alluded. But I for one, am not quite clear whether in those evolutions of which he spoke, they were performing those new steam-tactics which are at present in the signal book, that Captain Colomb had something to do with, or whether they were steam-tactics which Lord Clarence Paget was trying of his own, or were suggested to him by other Officers. Now I am not an old Officer, but I have had some experience in signals, and I am very sorry that Captain Inglefield was not at liberty to allude to them more than he has. The whole question of steam-tactics depends very much upon a matter of detail. I may remark in passing, that it has been too much the custom to leave signals almost entirely to the Signal Officer, or, perhaps, to the chief signal man, who is necessarily quite unacquainted, as a rule, with the real theory of tactics. It may be urged that it is a division of labour, but, at the same time, it very often causes confusion, for the Officer who gives the orders knows about tactics, while the man who carries out the details knows only about the signals. One of the commonest questions in fleet evolutions used to be, what is the "starboard line of bearing?" I did not quite understand Captain Inglefield's explanation of that. My impression is, that "the starboard line of bearing" by the old signal book was, that every ship should be in such a position, that on hauling to the wind on the starboard tack, and altering courses together, they would be in line of battle on the starboard tack. The converse would be the case with the port line of bearing; the ships being in line of bearing, no matter what position they bore from the Admiral, if they hauled to the wind together

on the port tack, they would be in line of battle on the port tack. If that has been altered now, if the starboard line of bearing means something different, as I understood, I should like to have an explanation of it, because I think it makes a great difference in the question of steam-tactics. I have undertaken, to a certain extent, not the defence of the old system of tactics, because I do not think they were at all applicable to the present day, but I think it has not been stated quite fairly. For instance, the wisdom of our ancestors was greater than to allow of only one method of line of battle, as one might have supposed from the diagram on the wall. You can form a line of battle in three different ways, or even in more than that, according to the old signal book. There were diagrams at the end of each signal; you could form on the van, you could form on the centre, and you could form on the rear. It would appear by that diagram, as if by the old signal book you could only form on the centre. (No.) I am informed that that diagram is only a representation. I would only repeat, that by the old system you could form line of battle on the van, and the Admiral might lead the van if he thought proper to do so. In changing divisions, one division to go across to the other side, and form the other division, that is to say, the starboard division to form the port division, and the port division to form the starboard division, as Captain Inglefield explained it, I should like to know whether, in the new signal book (I believe they call them now, first and second divisions), they change places, whether they alter their names or not. I have thought it right to ask those questions, and I hope they are not out of place.

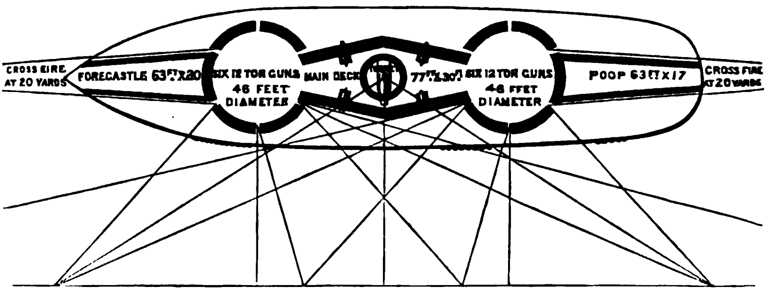
Captain INGLEFIELD: To take the gentlemen who have made remarks upon my paper in the order in which they have spoken, Captain Colomb alluded to the Admiral's position in the Fleet of which I spoke. It is due to him to say that it was only this afternoon that the Secretary of this Institution lent me his paper on the Battle of Lissa; this I had not seen before, as I was abroad at the time it was read. In it I remark that he exactly adopted the notions that I have stated. It is right I should say that I am not the first person to suggest that the Admiral's position should be an independent one with regard to the line of battle. With regard to "ramming," Captain Colomb's remarks only referred to those which I made, and with reference to the difficulty of ramming. But as the ramming properties of ships, and the use of rams in a squadron, have been alluded to by another Officer, I will take that subject up by saying that I perfectly agree with that gentleman when he told us that it would be very difficult for two squadrons, coming at the rate of ten knots, to ram each other, very difficult for them to strike each other exactly. It is for that very reason that I suggested that the rams should be brigaded together, to act when the enemy was paralysed, either by some disaster, or by "the first shock of battle," which was the expression I made use of; and that it is then I believe the rams will be more useful than if they were to be the leaders of the Fleet. At the commencement of the action, every ship being in her best trim, having her full power, and able to steer perfectly, it will be very easy to my mind to avoid the blow of any ram that is clearly directed towards your ship. But, on the other hand, when a ship has been disabled or paralysed by a broadside, or by something which has happened on board of her with the first collision, it is then that I think the ram, not having been engaged, in a perfectly cool,—almost cold-blooded manner,—may run steadily into another vessel, because she has all the chances on her side, while the other is comparatively helpless. There I agree with that gentleman, and I agree with him in saying that the rams ought to be placed in the rear of the squadron. Another gentleman remarked that it is hardly fair to talk of the "Gibraltar" and the "Victoria" as fair examples for exemplifying the working of a line of battle. The "Victoria" was changed, before I left the squadron, for the "Caledonia;" and we had at last a very fair number of iron-clads with which our evolutions were carried out. We were out, I believe, on three or four occasions when every signal which our old signal book contained, was practised; not once or twice by the Admiral, but several times. With regard to the old signal book, I may say that the Mediterranean squadron had only the old signal book; while the Channel squadron was purposely sent out to practice the signals in the new signal book. My ships,

the "Prince Consort" and the "Royal Oak," were detached from the Mediterranean squadron and attached to the Channel squadron on purpose to make an efficient iron-clad fleet. In the Mediterranean squadron we had the opportunity of testing the old code of signals; in the Channel squadron we had the opportunity of testing the new code of signals. Being the leader of the lee division on both occasions, I had the fullest opportunity of seeing both systems thoroughly tested. The practice of naval tactics ought to be carried out whenever an opportunity occurs. Having been on one or two occasions desired by the Admiral in the Tagus to take out the steam-launches and go through evolutions in the open waters below Lisbon, I found it was an admirable way, and at a cheap rate, of teaching the younger Officers to practise Naval Tactics. It was with that experience that I suggested how convenient it would be to allow Officers on half-pay to assemble on board gun-boats at Sheerness or Spithead, and give them that experience in evolutions which had been gained by those who were in the Channel squadron. With regard to the line of bearing, the meaning of the expression, "the line of bearing," has not been altered in the new signals. It remains exactly the same as in the old, and is exactly the same as described by the gallant Officer who spoke upon the subject.

The CHAIRMAN: It remains with me to say a few words before I convey the thanks which I am sure the meeting will give to Captain Inglefield. In all that he has said about the necessity for instruction in naval tactics to us who are on shore, I fully agree. I think it is quite necessary that we should learn whilst we are upon shore. Of course I am speaking for others, as well as for myself; and to those who are young I consider it a great advantage indeed, to have the opportunity of hearing an Officer, fresh from such drilling as Captain Inglefield has gone through, with so much intellect on his part,—I say it is very advantageous indeed, that we should all of us be able to learn from such an Officer our lesson here in peace, which, shortly, we may have to practice should we go to war. I must also say another thing, namely this, that when war does come, it will not be mere theory. Of course, many things will be adopted roughly in practice which we have hardly imagined in theory; and among those evolutions which are done very well on paper, some may be quickly done, and some may be done by the rule of thumb far better than by right angles. But I feel convinced that the Fleet that is most practised in evolutions will be the one that will be best in position to fight its battle. It is coming back, as we must come back, to original ideas. We must remember the Roman word for "army" signified "exercise." So it is with the "fleet," our word for a "Naval Army," we ought to be exercised and drilled continually; and the Fleet which is most thoroughly drilled will, in the day of battle, be the best, as far as that goes. That diagram (Plate XXII, fig. 3) seems to me to be an excellent thing. It is an easy way of putting into the mind of the Officer of the watch, at a moment's notice, that which it is his duty to do instantly; because he must act instantly in many cases, putting his helm one way or the other, before he can send down to the Captain. He requires a reference to the diagram. If he has not got the movement in his mind beforehand, of course the ship may suffer and he may suffer. That diagram will enable him to put the ship into position at once. I think it a most excellent improvement. With respect to the position of the Admiral, every person must have his own opinion upon these subjects. My own opinion, as an Admiral who has pretty well passed the service, is that the Admiral must certainly be detached from the actual line; he must be able to move everywhere. But he must also not be in a tender or anything inferior of that kind; he must be in a swift, first-class ship, because it is not only that he has to direct, which is his first duty, but we must remember that on him devolves much more than that, he has to set the example when it comes to that *melée* which has been spoken of. He may send his squadron into action, but he is the person to show the squadron how to go into action, and to do it himself. He must be the person who must lead the reserve in the crowning attack; he must be the person, as soon as he has prepared all the manœuvres to win the battle, who must go into it himself. He must do something more than look on. The signals in action will be very few, indeed. In our old naval actions, where, Heaven knows, they had time enough to think of these things, we find the signals made during the action amounted really and truly to only two or three. If that was the case where there was only the smoke of the guns, and

not the smoke of the engines, what will it be in the present day, when ships are moving with wind and steam, 10 and 12 knots at each other! The whole thing must be settled beforehand, and then the Admiral must trust to the individual exertions of his Captains after he has made his general dispositions. There was another point mentioned about "ramming." I do not quite agree with Captain Inglefield, about putting the rams so far astern. I have not the least doubt that there will be very great difficulty of ramming in the first line. But supposing an Admiral puts his ships in two efficient ramming lines, I believe the second line will be the one that will ram. The first attempts that will be made will result in confusion and *melée* between the two first ships that grapple; and it is those that come up immediately afterwards that will be able to act upon those which are still unscathed, but have lost their way; that is the time for ramming. But I think the time for ramming will be partly gone, when ships are totally disabled. If one ship rams another, she is in the greatest danger herself from the second astern of the ship she is so ramming. I do not wish to detain you any longer, but I think we must return our best thanks to Captain Inglefield for the admirable paper he has given us. It is an admirable lesson for us all. As an Officer of the old school of tactics, I think it is a very great lesson to learn from a junior Officer who has recently been employing his mind and his talents so well as he has done.

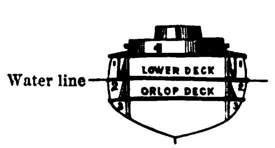
Captain EDMUND WILSON, R.N., explained models illustrating the construction of an armour-clad ship of his invention. Her length 300 feet, beam 64 feet; armament thirteen 12-ton guns in turrets; and four shell guns 8 feet in length, and 11-inch bore; three guns commanding every point of the compass.



3 guns command every point of the compass.

Concentrated broadside from five 12-ton guns and two shell guns.

3 guns command every point of the compass.



Transverse section.

1. Upper compartment, with the armour sloped to 22° and showing chain mantlet. 2. Lower compartment wholly under water, armour sloped as above, and then closely packed with cork. 3. Coal bunkers.
Draught of water, 24 feet.
Equipment: A full-rigged ship.
Engine power: 1,000 horses.

Captain INGLEFIELD: Is that auxiliary rudder which I see in the model before the screw?

Captain WILSON: Yes, before the screw. If you want a ship of this length to come round very quickly you would use the auxiliary rudder.

The CHAIRMAN: The principal advantage of your system is putting the iron on the inside, and the wood on the outside of the vessel, as if she were a wooden ship?

Captain WILSON: She is a composite ship, with iron inside, and wood outside in contact with the water. She has thus all the rigidity of an iron ship, with the advantages of a wooden ship, as far as relates to her bottom keeping clear of weeds, &c.

The CHAIRMAN: What would be her power of ramming? Does she ram with an iron or a wooden stem?

Captain WILSON: The stem would be of wood, protected with an iron face; this part [pointing] would be filled in solid.

The CHAIRMAN: Have you thought of the accommodation inside for stores and men, for the habitat of the ship?

Captain WILSON: Yes, she has everything that a ship of the usual breadth has. My ship is 4 feet broader than one of her length generally is; she is in fact one ship inside another. There is one more point I should like to show you with regard to "ramming." In consequence of the form of her midship section, owing to her extra breadth, Mr. Reed's present ram-stem, as represented by this model, on striking her, would not, as you see, take the bilge at all. Of course the only part where a ram could do any damage, would be under the armour. With an ordinary ship, the ram would go right into her; but with this ship of mine, with external wood, and with internal armour, the ram would not damage her.

The CHAIRMAN: We are much obliged to you for bringing these models, and explaining them to us. I do not know that we should agree with you in all the details, and I regret that we have not more time to consider them, as there is a gentleman who wishes to show us a filter of his invention.

Mr. W. B. LORD, R.A.: The filter which I am about to show you, is the result of some little experience in roughing it in wild countries. It has so happened, that in the course of my wanderings, I have been placed in positions where the water was particularly bad; this induced me to turn my attention to make something that would constitute a rough and ready filter for men on service, for the explorer, the naturalist, and the emigrant, to have always at hand, to be able to use it for a variety of purposes, and by its aid to get water comparatively good for drinking purposes. The filter is simply a pint cup composed of block tin. In it a man can boil a little tea, as well as use it for ordinary drinking purposes. In it I carry a small tube,—this which I now show you, is of vulcanized india-rubber,—but those which I shall have made for issue, will be of leather. Vulcanized india-rubber, strangely enough, undergoes a sort of disintegration on being subjected to a tropical sun; why, is hard to say, because vulcanized india-rubber exposed to an equal degree of heat in an oven is not affected, as it is by the action of the sun; I shall therefore employ leather. When you want to use it, you

put the filter in the water, and on exhausting the air by suction you perceive that in a very short time I get a cup of clear water. [Mr. Lord exhibited this practically.] The water has to pass through a stuffing-box, which contains a small piece of sponge, little pieces

of woollen or cotton material,—even moss or powdered fibre from a tree will answer the desired end. When the stuffing gets soiled, you have only to take it out, wash it, and put it in again. There is in the filter a little hollow constituting a kind of grating, which I call grating No. 1. After passing through it, the water has to pass through a second. Both these gratings are attached to the stuffing-box, which is filled with either hair, matting, wool, or cotton. Supposing you arrive at a deep pool, where it is difficult to get height sufficient for you to operate with it as a syphon, you have only to exhaust the air repeatedly to get as many pints of water as you want; but if you can dip the water up in a pail, and then exhaust the air, the tube will act as a syphon [showing]. My object in using sponge is to get rid of the insect larva, ova, insects, and the particles of decomposed and other matter which one finds in the waters of tropical climates. On many occasions I have had to make all sorts of makeshift filters. In the Crimea, I took a wine bottle, knocked the bottom out, put a piece of sponge into the neck, hung it up, and made the water filter downwards; that kind of filter, however, is inconvenient to carry about with you. Another way was to take a bunch of grass, twist it into a coil, turn it down, and allow the water to run in at the upper, and out at the lower end; but that was a rough system of filtering. Again, I used to get a piece of the ordinary cloth of the country, put it loosely over the top of a

pot, and pour water through it. With this new filter I shall have no such difficulties. I should carry it in one of my holsters, or in my pocket, and it would be always at hand for use.

The CHAIRMAN: Is there any charcoal in that filter?

Mr. LORD: There is no charcoal in this; but I should recommend, where you really have very bad water, that a common bag or net of charcoal should be put into the pail when you can carry one. Nearly all those filters which are made with the view, as it is supposed, of freeing water by chemical disinfectants, must as a matter of necessity, be very slow in their action; for until water is subjected for some considerable time to the action of any antiseptic, it cannot be influenced by that antiseptic. It is not simply the running of a stream over charcoal that frees that stream from impurities; it is the long-continued contact with charcoal that frees it. Therefore, where you have a vessel which you wish to fill instantly on the march, charcoal would not do that which the public supposes it does; it has not time to do it. I quite admit, that if you have a large vessel filled with charcoal, and it has time to act, it would be very desirable, but when you are on the march, and want a draught of water at a moment's notice to save life, you will not find charcoal of much use.

Captain COLOMB, R.N.: What is the cost of your filter?

Mr. LORD: It may cost possibly a shilling or eighteen pence for one made of block tin. I think the original one I made, cost me fourteen or fifteen pence; it was made of common tin soldered; but I should recommend those made of block tin as being the most serviceable.

Major-General BOILEAU, F.R.S.: It appears to me that the invention submitted to the meeting is one well worthy of general introduction. It is not the first portable filter made use of, because a large number of carbon filters were made and sent out to India for the use of the soldiers. They were made much in the same way as this; there were blocks of composition, to which there were long tubes attached; they were thrown into the water that was often very dirty, and by suction, water was produced that was drinkable. The great advantage of this filter is, not only its simplicity, but the very many purposes to which it can be applied. Of all similar filters of this kind, it appears to me that while they supply one of the most urgent requirements of man in a hot climate—a draught of water that is wholesome to a certain extent—none of them chemically cleanse the water from that which is prejudicial to health. Of all that I have seen, there is not one that answers the purpose so well as the one which has been explained to us this evening.

Captain BURGESS: Colonel Beauchamp Walter, who has served in India, and to whom I showed that filter, thought it of the highest value, and that every soldier should be supplied with one of them.

The CHAIRMAN: I am sure the meeting thanks Mr. Lord for having brought this filter to our notice.

LECTURE.

Friday, May 22nd, 1868.

General Sir WILLIAM J. CODRINGTON, G.C.B., in the Chair.

ABYSSINIA.

By Mansfield Parkyns, Esq.

Mr. Chairman, Ladies and Gentlemen,

When the compliment of being asked to give a lecture at this Institution was paid me, I was in some difficulty as to the subject matter I could offer. There is nothing in the military tactics of a semi-savage race. The British expedition now in the country seemed the only topic appropriate to the Royal United Service Institution; and that I felt was a field on which I could hardly venture, as I could only offer matter that had already appeared in the public press, not having travelled over the exact route to be followed by our troops.

A member of the Institution, however, kindly suggested to me the course which I shall endeavour to follow, namely, not to interfere with that most interesting topic, but to consider it my part merely to give a sort of introduction to a lecture, which it is to be hoped will, before long, be delivered by some Officer who accompanied the expedition.

My matter will therefore be rather ethnological than military. I shall attempt, so far as limited time and ability will allow me, to give you a general idea of the country and of the people we have to deal with, leaving to some one better qualified the task of telling you how we have dealt with them. I may venture, however, to say that the events which have lately occurred, fully justify what I wrote of the prospects of the expedition at the beginning of the year: "commanded "as it is, whatever can be done, will be done." And I am sure that when we have full details of what has been done, it will be agreed by those most competent to judge, that though we have not had a chance of winning much glory in actual fighting, we have done wonders in the equally important matter of moving a large force through a most difficult country.

As to Theodore's conduct, I may again quote myself, when I said

that it was impossible to calculate on anything, where "so much "depended on the whim of a self-willed, daring, and obstinate half-"savage." But in those words I hardly conveyed what I meant. Had he been an ordinary savage, one might have made a pretty good guess at what he would be likely to do. But I had heard so much of the wild, almost insane way in which Theodore sometimes acted, that I felt that no reliance could be placed on any estimate of him, founded on general knowledge of the ways and motives of his countrymen. Once, I did venture to speculate, and lost. When the news arrived that our troops had reached within a few miles of Magdala, without having met with any opposition; that the prisoners were better treated, and Mr. Rassam freed from his bonds, I confidently asserted that Theodore would come out and meet Sir Robert Napier with open arms; express his gratification at the high honour done him by his dear friend Queen Victoria, in sending him so splendid an embassy; invent 1,000 excuses for the past, eat any amount of humble pie, and invite his Excellency the Commander-in-Chief to join him in doing the same by any amount of raw or broiled meat. Had he done this,—and I know many a nigger who would have tried it,—I can't see how Sir Robert Napier would have acted, in face of the Government assurance that the sole aim of the expedition was to recover the prisoners, and that object being gained, not to interfere with the existing state of affairs in the country.

I cannot understand why Theodore acted as he did, and am still inclined to believe that he had no intention of fighting till the last moment, when he did so under the influence of some fit of passion or of drink. Possibly, however, he may have been so hampered by rebels as to have been unable to act otherwise.

As for Theodore himself, his real name was Carsai. He was born in Kuâra, one of the westernmost provinces of Abyssinia, son of a man of no eminence or wealth, though claiming lineal descent from Menilek, the traditional son of Solomon the Great, and Maqueda, the lovely Queen of Sheba. After the death of his father, his widowed mother gained her livelihood by collecting *kousso*, the native remedy for a national complaint, while the future Theodore picked up his on the roads as a brigand. In such a career he was naturally subject to many turns of fortune; at times hiding away alone; at times leading a considerable band; till at last he gained such celebrity that a large body of men joined him, and from brigand he turned rebel, in which new career he met the troops sent against him so successfully, that the daughter of Rus Ali, then great chief of the Amhara country, was given him to wife. These sort of alliances have not, however, much effect in producing peace, which was soon broken.

Theodore's good luck never failed him, for when he ought to have been beaten, chance gave him the victory, and four years of continued successes left him sovereign by conquest of all the independent sovereignties of Northern Abyssinia. In February, 1855, he was crowned Theodoros, King of Kings, Emperor of Ethiopia, by the hand of the Coptic Bishop of Abyssinia.

I have seen it stated that he assumed the name of Theodore, in pious

gratitude, because God had given him the victory. I don't suppose he was aware of the meaning of the Greek word. He undoubtedly assumed the name on account of an ancient popular tradition that an Emperor named Theodore should re-unite the old empire, and restore its much-talked-of ancient glories. He rose and fell, for his fall seems to have begun before our intervention, as many other men have risen and fallen before him.

Kingdoms, if not the whole empire, as in his case, have been lost and won in Abyssinia from very small beginnings.

It is hardly a caricature to say that men have risen almost, if not quite, to what might be called a throne, at the small cost of *one dollar or thereabouts.*

So it was said long before Theodore was known to fame, and his career was like that of many who had gone before him.

The old saying was that a daring, active man, especially if he had the remotest possible claim to relationship with any former chief, had only to buy a small drum and hire a small boy to carry it, and from that commencement he might win a kingdom. First he would waylay and rob a few old women on the road to market, half a dozen men would join him on the strength of the loot; a farm-house plundered would add a dozen more; a hamlet would bring a score or more recruits, and so on in geometric progression till his small boy and drum grew into a formidable army, which would cling to him so long as he was successful, but desert him to a man, if by ill-luck he met with a reverse.

This is by no means so broad a caricature as it may seem of what has really occurred, or of the native character. I have always found it so, and was amused on my return by a great phrenologist pronouncing as his first opinion of a very faithful native servant of mine: "He will be very faithful so long as it is worth his while to be so."

When the news of Theodore's death arrived, I again fell into a mistake. I asserted boldly that he had not committed suicide, but in all probability had dressed the body of some man who had been shot either by him or by our people, in his clothes, and so made his escape in disguise. That would be a very likely trick for him to play, while nothing is so unlikely as for a native to commit suicide. I don't believe I ever heard suicide even spoken of, either in Abyssinia or the adjacent countries during seven years travels. But I was corrected, being told that the body had been identified by the captives. Supposing this to be the case, and that Theodore died shot, I should still have been sceptical as to whose hand shot him, were there not good evidence on that point; I should have thought it much more likely that some one of his followers, not being quite so fond of fighting to the death as his master was, shot him in order to stop matters. So we may take leave of Theodore as an exceptional character, so unlike the rest of his race that he will doubtless find a special biographer.

And now as to his country—Northern Abyssinia is for the most part a portion of an immense table land, in many places mountainous, but with mountains springing as it were from the summit of one large flat-topped mountain. Some of these standing isolated on the level, or

in groups, are of singular form, looking at a distance like immense towers built on the top of artificially raised mounds, so regular are some of them in form; but on nearer approach, one finds the tower to be a perpendicular-sided rock, often of great area, and the mound to be a mass of debris which has from time to time fallen from it. These are the "*Ambas*" or natural rock forts we have heard so much of, and of which Magdala is one. But though perhaps impregnable to native troops, Magdala cannot be compared to some smaller rocks for natural strength. There are some which can only be entered by means of ropes let down from above.

The following story may be told of how a Tigré chief got possession of one of these mountains, which by right belonged to him, but which, being a rebel, he had left in charge of some monks. The monks having collected great wealth and vast supplies of provisions there, were loth to give it up, and made loyal protestations of their duty to the ruling powers, their excuse.

The post was very important to the chief at that time, and the stores, which were for the most part the revenue of his own hereditary province collected in his name during his absence, still more important for his hungry troops; but in vain he tried every scheme to get his own again.

Force was out of the question, as the monks had only to draw up their rope, and setting at defiance the best army in the land, hold out for a longer period than any rebel troops could venture to beleaguer them. So the chief pretended not to care for it, cultivated the friendship of its occupiers, and even deposited some more of his property in their safe keeping.

After a considerable time, happening to pass the mountain, he expressed a wish to see the convent. The abbot granted his request conditionally that no one but his shield-bearer should accompany him. He mounted, visited the place, talked of sending more property, and made himself so agreeable that the reverend brethren proposed some refreshment. He feared he had not time, must be off, &c., &c., but being pressed, at last consented to accept their hospitality. The monks regretted they could only offer him a mutton repast. That difficulty was easily removed. They were not at all averse to good fare, and a fine fat cow which the chief had below, was ordered to be hauled up. In every great Abyssinian house each department has its particular servant, who has an indefeasible right to his particular perquisite. I have published all these details but have not space to give them here, suffice it to say that the cow could not possibly be killed, or the raw meat served, without the presence of the Chieftain's butcher, butcher's mate, server, and knife cleaner. As a matter of course, they accompanied the cow. The convent beer was good, but there was first-rate mead below, so to please the convivially disposed brethren, a supply was sent for, and brought up, accompanied, of course, by the brewer, pourer out, and waiter. And as the monks grew more merry and less wise, spirits and various other things were suggested and ordered up for their benefit, each article accompanied by its proper attendant. Drinking led to a desire for music and dancing, so the

chief's ambilta or reed band was sent for, and thus, one by one, a good party of well-armed men found their way up, just to please the pious monks.

The chief said nothing till the abbot suggested that it was getting late and time to break up, on which he replied in the tone of a polite host, begging the brethren to stay a little longer, it was yet early, they must finish another jar of mead, but if they must go, he hoped that it would not be long before they had another jolly evening together. The drunken abbot, monks, and lay brethren stared about them at this rather too polite invitation, and to their dismay perceived, that not only they themselves had hauled up a large party, but that these, profiting by their merry-making, had in their turn hauled up all their comrades. The monks began, some to weep, some to bluster, each according to the particular stage of intoxication in which he happened to be. The Lord Abbot swore he wouldn't go, but the chief persuaded him and his brethren, by hinting that there was a speedier way of reaching the bottom than by the rope.

Axum and Adoua, the ancient and modern capitals of Tigré, seem to stand on a plain with lofty hills rising from it, yet their heights above the level of the sea are 6,000 and 7,000 feet respectively. Gondar, capital of the Amhara country, stands rather higher than Axum, and the lake Dembea (or Tzana) is at about the same altitude as Adoua.

The fact of its being a lofty plateau is realised, when after travelling for many days over the seeming plain, you come suddenly on one of the deep valleys by which it is intersected. The River Mareb in Tigré, and the Taccazy, which forms the natural boundary between the Tigré and Amhara countries are the chief of these valleys, which are *sometimes miles broad*, descending some thousand feet by steep rocky slopes, covered with jungle, to the broad river bed below; sometimes comparatively narrow, with perpendicular rock sides, like vast rents in the ground. The mountains of Simyen spring from the west bank of the river Taccazy, their highest peak rising 15,000 feet above the level of the sea and 12,000 above the nearer portions of the river-bed. Patches of snow or hail of much greater extent than those on the Sierra Nevada, lie on its summit during the greater part, if not the whole, of the year. The Tigréans east of the Taccazy, differ in language, and, to a certain extent, in dress, manners, and customs, from their neighbours, the Amharas, on its western bank. The Tigré language nearly resembles the ancient Giz, or Ethiopic; while the Amharic is either a very corrupt dialect of the Giz, or a distinct language, with a good many Ethiopic roots introduced into it.

The general plateau drops from its eastern edge several thousand feet to the strip of low land lying between it and the Red Sea, on the north toward the Nubian basin of the Nile, on the west and south to that of the Abai or Blue Nile.

It will be readily understood that with such variety of altitude, a country lying between the 10th and 15th degrees of north latitude, must enjoy almost every variety of climate.

The fir, thorn, and blackberry abound on the mountains of Simyen and

Woggera, and on the high plains of Gojam to the south. Fleas, too, are plentiful in the first-named district.

The middle range would grow almost every kind of European fruit or corn.

In the few places where the vine is cultivated, it thrives luxuriantly. Wild olives, oranges, lemons, and various kinds of stone fruit are frequent. In the neighbourhood of Lake Tzana, rice and the sugar-cane now grow wild, possibly having been cultivated there in former times. Indigo has been tried with success; cotton of very fine quality is grown in many parts; a large quantity of coffee is exported from the neighbouring Galla countries to the various ports of the Red Sea, whence no doubt, a portion finds its way to Europe as "real Mocha."

In the more temperate altitudes, the mimosa, jessamine, and Cape plants bloom in profusion, while the monkey bread-tree, tamarind, bamboo, and various orchidaceous plants luxuriate in the hot-house climate of the lower valleys. It is the same in point of salubrity. An equable, though warm temperature, makes the middle and higher districts as healthy as need be, while at certain seasons of the year, nothing could be more deadly than the lowest ones. The unhealthy season is obviously after the rains, which fall in the highlands between June and September, and on the seaboard about two months earlier.

Tropical rain is not like our April showers; in one hour as much will fall as in three of our English thunder-storms. The earth cannot absorb it fast enough; in a few minutes the tiny rippling stream becomes a torrent, tearing down the mountain side, carrying with it its quota of what has made, and is still making Egypt. Scores of such torrents fall at once into their carrier, or secondary stream on the table land. I have crossed one of these in the morning, when it contained hardly water enough to wet the soles of my feet, and gone to see it in the afternoon when it was roaring down, many feet deep, and carrying away cattle, haystacks, and the remains of huts which it had destroyed at some higher part of its course, where it had overflowed its banks.

These secondary streams in their turn rush into the main valleys, each of which thus collects the water-shed of a vast tract of country.

In many places the Mareb and Taccazy are in the dry season merely rivulets, scarcely trickling between wide belts of sand bordered by thick jungle. When the sudden supply of water reaches them, they overflow both, in a broad red flood. The rains ending, they as rapidly return to their former bounds, and a rank vegetation springs up in the hot steam from the decaying remains of last year's growth.

The same thing occurs, even without the inundation, in the northern and western plains of the lower levels; and nothing can be more rapidly fatal than this poisonous malaria from decaying vegetable matter.

We may now hope that the expedition will be well out of the country before the dangerous season sets in; but though not generally of the worst form, there is often a good deal of fever on the coast about this time of the year.

With this rough sketch of the general features of Northern Abyssinia, I will turn to its inhabitants.

The Abyssinians are a mixed race. The word Abyssinia is probably derived from their native name Habash, which, I believe, in the Giz, or ancient Ethiopic language, means a mixture. In some of the provinces of Tigré, a mixture of various qualities of corn is called Habash to this day.

They count among their progenitors many settlers from various countries. Tradition alledges that a number of *Jews* followed the Queen of Sheba when she returned from her visit to Solomon. Numbers more are said to have taken refuge in Abyssinia at the various periods of Jewish troubles. Under the Ptolemies there were, no doubt, a good many foreign settlers. The early Christian Greeks sent missionaries, accompanied, it is said, by many artisans and adventurers. Then the Portuguese sent an expedition to assist the Christians against the invasion of the Mohammedans, and many of the soldiers settled in the country. The marks of a mixed race are very clear in the variety of stature and complexion. In a pure race, such as some on the White Nile and interior of Africa, there is great similarity in form and feature, almost identity in colour, and a remarkable evenness in size. In some tribes that I have seen, almost every man is within an inch or two at most, of the height of any other man in the tribe; some races being all very much below what we should call average height, others as much above it.

But the Abyssinians are, like ourselves, very varied in all points. In stature they run from 5 ft. 2 in. to 6 ft. 2 in., or even more; in colour, from almost jet black to almost as fair as an Egyptian; and the difference is remarkable, even in brothers and sisters of the same parents. I have often seen a jet black brother, with a nearly white sister, and *vice versâ*. I once lodged in the house of a man whose skin was of the mildest *café-au-lait* colour, and whose features were remarkable for a high forehead and a far more prominent nose than even Punch ever ventured to give himself or the Iron Duke. His sister was hardly so fair or well favoured as a Nouba slave. Both their father and mother were alive, the father very like the son, the mother quite as fair; but on inquiry I was told that their grandmother was dark.

Generally speaking, both men and women are remarkably well made and good looking, often handsome in feature. There is not the least appearance of the west coast negro in either form or feature. The men are usually deep chested, and models of symmetry upwards. Sometimes they fall off a little in the feet and legs, but so slightly in comparison with the genuine negro, that I attribute it to hard work and going barefoot from their childhood. The same may be said of the young girls. Like the women of all hot climates and slight costume, they age very rapidly, and are sensible enough, therefore, to exchange the becoming semi-nudity of their girlhood for a long loose robe, which entirely conceals the figure before its beauties are likely to fade. For dress, the men wear, cotton pantaloons, tight fitting, and reaching, according to the fashion of the country or the taste of the wearer, either to a few inches above, or a few inches below the knee. There is ten times as much fashion and fancy among the fast young men of Abyssinia in respect of the cut and stitching of these very simple

nether garments, as among the most exquisite of European Exquisites, in respect of their more elaborate costumes; and an experienced eye can as readily detect a soldier or townsman from a country bumpkin by the cut of his cotton, as he could in Europe by the cut of his cloth. A cotton belt, varying from 15 to 60 yards in length, by a yard wide, and a large square white sheet, with a red or blue border, worn very much after the manner of the Roman *toga*, and possibly in imitation of it, completes the costume. A belt 60 yards long and a yard wide, may seem an extraordinary article of clothing, and certainly implies a vast amount of turning round and round on a pivot when getting into it. But the weight of cotton does not increase with length, the longest being exceedingly fine and expensive, and therefore worn only by rich men. An ordinary gentleman's belt would be about 30 to 40 yards. It is worn as a sort of defensive armour, and serves to protect the lower part of the body from anything but a bullet, or a very well delivered lance.

The sheet, or "quarry," as it is called, is the cloak by day and the bed by night. When on a hunting expedition, or fighting, it is laid aside, and a piece of velvet, or the skin of some animal, worn in its stead; great warriors wearing the lion's skin, or a velvet mantle covered with silver ornaments. There is much fashion, too, in the skins that are proper to wear and those that are not so. Among the most fashionable are those of the lion, black panther, cat-leopard, and of a particular sort of jackal; the most usual of all and much esteemed is that of a peculiar sheep. All these skins are cut so as to hang in broad or narrow strips round the wearer; they are lined with red cloth or chintz, and the top edge bound with red morocco, stitched with gold and silver tinsel threads, and clasped with a double row of green and red amulets, the ends of the leather binding, hanging from them so as to have somewhat the effect of the bow and ends of an English lady's bonnet-strings. The skins of the dog and hyena are never worn; those of the leopard, only by a sect of dervishes in Northern Abyssinia, though they are in vogue among the Galla and Shoa soldiers; those of the ordinary domestic animals only by small farmers and their ploughmen.

I must return to the peculiar sheep whose skin I before mentioned as being the most esteemed for ordinary wear, because the animal itself is rather a curiosity in natural history. The skins are brought from the Galla countries of Yejjo and Wara Himano. Although, as a rule, the sheep of hot climates have no wool, but short hair, like a goat, and I believe it is true that sheep imported with wool, in the end lose it, yet this breed has extraordinarily long and straight wool of beautiful softness.

Some years ago I told a friend of mine who is much interested in farming, that I had measured wool of the length of a cubit and a span and three finger widths; or about 2 feet 5 inches. He said nothing at the time, but two years after confessed that he had taken my statement as a traveller's tale, never having seen, read of, or heard of such wool in any part of the world. I am quite prepared that many here present should hold the same opinion as he did; but at the same time that he confessed his scepticism, he made the *amende honorable* by

presenting me with a card, on which was wound a lock of wool, grown on the back of a Lincoln sheep during the two years of his infidelity, and measuring a few inches longer than my statement.

The Galla skins are generally dyed black, when not naturally so, but are sometimes worn in their natural brown and white. I have been told that the sheep are fed on meat and milk, and kept always on couches, their wool being regularly combed and tressed. In such case their lives are like those of some individuals of a higher order in natural history, devoted solely to outward appearance, and I am credibly informed that in both cases, when the superficial beauty goes, there is nothing left worth having. At any rate it is so in the case of the sheep, for when skinned, there remains nothing but a muttonless skeleton.

The native weapons of the Abyssinians are the lance, sword, and club. The lance-heads are of various patterns, but in later days they have shown their judgment in giving up the flat broad head for the square or diamond-shaped. The shafts are of tough pliant wood, of natural growth, or sometimes of the solid bamboo, and are balanced by a roll of iron on the butt. Many of the Abyssinians are tolerably expert in throwing the lighter sort of lance or javelin, striking an object from 30 to 40 yards distant with much precision. Two great chiefs in my time were said to have thrown a lance over the extraordinarily large tree, and column at the town of Axum.

The heavier lance is most generally used, and is never allowed to quit the hand, though it is often thrown at the enemy, sliding through the fingers and caught by the butt.

A well-delivered lance stroke will often pierce the toughest buffalo hide shield, and kill the man behind it, if he be awkward enough to receive the point square, instead of glancing it off by a side movement of his shield.

The shields are round, and nearly a yard in diameter, neatly made, not flat, but curving upwards from the edges to the centre. They are often ornamented with silver, and with strips of lion's mane, or a lion's tail, sometimes with brass plates, in the case of a poor but ostentatious soldier; this, however, is going out of fashion, as brass plates are seldom anything but patches to hide a bad shield.

The swords used in Abyssinia are either cheap showy blades imported from Germany, or home-made of the native iron.

The soldiers were getting rather tired of the German blades when I was there, for the somewhat sound reason that they were brittle. "If your sword break, where are you? But if it bend, you have only to sit upon it, and it's all right again." But whatever the blade, they make it perfectly useless by fitting it into a rhinoceros horn hilt, so cleverly constructed, that if, in striking, the wrist bend ever so little, a sharp point of the hilt inevitably pierces it. In consequence, though I have seen many sword-cuts on the head, I never saw more than the scalp injured.

The Abyssinians have no notion whatever of swordsmanship, either in the eastern way of dexterous cutting, or the European, of skilful warding.

Beside the ordinary sword, they have another weapon called a shotel, which is in form like an immense, and very crooked reaping hook. It is difficult to stop a blow from this weapon either with shield or sword, as the point will come down perpendicularly on to the head, while from its shape the middle of the blade is two feet above it. To counteract its dangerous nature, it is such a clumsy, top-heavy article, that it is a very difficult matter to direct a blow with it. Both sword and shotel are worn on the right side, buckled close to the waist, and sticking out behind like a tail. The scabbards are, where it can be afforded, of scarlet morocco, sometimes patched with silver, and always continued a foot longer than the blade to a narrow point, which is turned up, as if to add to the tail-like appearance. At the end of this, the shotel has a round ball of silver as large as a walnut, while the tongue of the blade of both sword and shotel is clenched at the butt of the hilt by a dollar, or a silver filagree ornament called a timbora.

The natives themselves appreciate these weapons as ornamental, rather than useful. They say:

" A great long shotel, with its silver ball,
" Goes down with the women, and that's all—
" A first-rate sword with its silver knob,
" Goes down with the women, that's its job."

Great chiefs, on state occasions, and in battle, wear coronets and large bracelets of silver, chains, amulets, and other ornaments.

The dress of the women is simpler than even that of the men. Young girls wear nothing but a piece of cotton cloth wrapped round their waists and the end of it,—or in some provinces of Tigré, a black goat-skin ornamented with cowries,—thrown over the left shoulder; when they marry they change this costume for a long cotton shirt, and a sheet or quarry like that of the men. Both sexes plait their hair, which though woolly is long, flat on the head, from the forehead backwards, leaving ringlets hanging behind the neck, or sometimes a few on the temples.

Formerly young soldiers were not allowed to tress their hair till they had killed a man, when they shaved the head, all but enough for a single plait round it, a braid being added for each man killed till the fifth, when they were allowed to tress the whole head. Now-a-days, except in some of the remoter Galla districts, the number of tresses depends on the age of the wearer, rather than on his prowess. Young men and women usually shave the crown; while mothers and full-grown men plait the whole. Ladies have butter neatly dabbed on their hair, and then some sort of scent sprinkled over it, but the correct thing for a dandy is to appear in the Rotten Row of the country with a huge pat of butter placed on the top of his head, which gradually melting in the sun, runs over his hair, down his neck, and over his forehead into his eyes, causing them to smart disagreeably, if he forget continually to wipe his brow with his hand or his "quarry."

As may be imagined, the dresses of neither women or men are

long free from grease; but this is by no means considered important, especially among the men; on the contrary many young soldiers consider a clean cloth as "slow," and fit only for a woman or a citizen. In consequence they never wash their "quarries," and seldom themselves, except on St. John's day, which happens to come only once a year.

Tattooing is a custom imported, I imagine from the Gallas, as a great many Amhara ladies tattoo, and but few Tigréans.

Men are seldom more ornamented than by a design on one arm near the shoulder, but some women tattoo their shoulders, necks, arms down to the finger nails, ankles, and feet, nay even their gums, which are sometimes all blue, sometimes striped blue and the natural pink. From paintings in the temples of Egypt, we learn that ladies were in the habit of discussing their earrings near 4,000 years ago. I have been among blacks, whose ladies wore no clothes; but I have never yet been in any country white or black, clothes or no clothes, where the women did not wear some trinkets or jewellery of some kind or other. The Abyssinians are not at all exceptions, they wear a large silver hair pin in the hair, not for the real or assumed purpose of holding the hair together as in Europe, but for the simpler one of scratching. They have literally "rings on their fingers," which they cover almost to the nails, with silver or alternately silver and gold rings, and almost literally "bells on their toes," for they wear three pair of "bangles" on their ankles, and over the instep to the heel a number of small silver plates hung by chains to a silk cord, which jingle like bells as the wearer moves her foot. Beside these, an Abyssinian lady of fashion will wear three or four pair of silver bracelets, and half-a-dozen silver chains, suspending a large silver box, like a card-case, supposed to contain a charm, but more commonly some scented cotton wool.

They darken their eyelids with antimony, stain their hands and feet with henna, and make use, I believe, of various other aids to nature, almost as much as some English ladies.

I fear I cannot give a very high opinion of the Abyssinian character. They are savages with a sort of traditional smattering, not of civilization, but of Eastern barbarism. They have most of the vices of the savage without many of his virtues, and a good many of the vices of civilization without any of its advantages. They are not generally hospitable, are great beggars, generous in giving only when they expect a two-fold return; excessively polite in their forms of salutation, very coarse in all their ways and manners, vain, but by no means proud; pugnacious, but by no means brave. Still, I think, one must not be too hard with them, their faults are rather negative than positive, and much allowance must be made for the incessant state of insecurity in which they live and have lived for centuries from constant rebellions and changes of government.

Personal vanity certainly is a remarkably besetting weakness—"*in vino veritas*"—and the first symptom of the effects of liquor on an Abyssinian, of even the lowest rank, is that he begins to assert his greatness and other merits. Nine quarrels out of ten over the cups, begin by a man saying to his neighbour: "I love you very much, but

you are not half so brave or so handsome as I." In other characters the same feeling will take another place—a tipsy servant will believe himself a very great chief, seat himself in a dignified posture, and order his fellow-servants about, reproving them for peccadilloes they have probably been really guilty of, and which thus sometimes come to their master's knowledge.

As for mock politeness and begging, what I mean may be gleaned from the manners of a soldier or confidential servant of the upper class sent with a message from a great chief. He will enter your room with his shoulders bared in token of humiliation, and as if bashful in the presence of so much greatness, will pause timidly at the door, bowing low at your repeated salutations and invitations to seat himself. At last, as if having gained sufficient courage to speak, he will inform you that his master Goetana Ito so-and-so, sends you his salutations and "Good morning, good morning. How are ye since I saw ye? How are ye? How are ye? Very much!" On your answering "God be praised" he will make another bow and remain where he is. After a while he will consent to sit on the ground, in the lowest place in the room, but with great show of disinclination to take such a liberty. Then he will get up again and approaching a little nearer, deliver some other message of empty compliment. This time he will seat himself near your couch unasked. After a few moments he will rise again, and give you, in a confidential whisper behind the corner of his garment, the real purport of his visit, probably such as this:—"My master, Mr. So-and-so, sent me to you to say How are ye (&c., &c., *ad infinitum*), and to present you with this!" On which, with the greatest mystery, he pulls out from under his cloth a very small jar of honey, which his respectable master had probably filched from some old woman for the occasion.

But though I said this was the real purport of his visit it was only the ostensible one. The business, however, being transacted, he will advance by degrees both in his impudence and nearness to your seat, till, if he think he has gained favour in your sight, that is if you are anything but stiffly courteous to him, he will very likely arrive in time at the point of dropping accidentally on the edge of your seat, and at last of sitting comfortably alongside you; then, all his humility disappearing, he will arrange his garments as pleases him best, and making himself perfectly at home, tell you stories of his own and his master's greatness, and of their particular attachment to you. Retiring at last, when your mead is exhausted, he reassumes his mock humility, and begs you to name from your servants one who shall be his balderabba, or mediator with you. To him he confides the real object of his mission, and it becomes the balderabba's duty to hint to you that your particular friend Mr. So-and-so, from whom you have received 6d. worth of honey, which cost him nothing, is very much in want of a Turkey rug, a few yards of velvet, or scarlet cloth, or perhaps of all.

As to courage, it is a very difficult matter to decide upon, there being so many varieties of courage, so much dependent on habit. The Abyssinians, as I said, are very quarrelsome, coming to blows for the merest trifles, but although lances, swords, and clubs are the weapons

used in their quarrels, dangerous wounds seldom occur except when the combatants are madly intoxicated.

I should say that the Abyssinians are undoubtedly less brave than many tribes near them, for instance the Baza on their northern frontier and the Arab refugees adjoining them. This may depend a good deal on their mode of life. They are less accustomed to self-reliance than men who live by their own hands in the backwoods. Still I have known striking instances of individual courage, of two sorts—one that required to dash suddenly on a vastly superior but unprepared enemy, the other stolid indifference to physical pain. There were four chiefs about the time of my visit who were celebrated for both these sorts of courage. One was a *beau sabreur*, named Gurra Rafaël, a most daring and impetuous cavalry leader, who shortly before my arrival had been cruelly murdered, by the order, it was asserted, of another of the four, namely, the Balgadda Araia, a claimant of the throne of Tigré. Gurra Rafaël was taken by stratagem, his eyes burnt out by a blacksmith, and then he was stabbed; to the last he never uttered a complaint, but only taunted his murderers and shouted his war cry.

The Balgadda was a sort of Abyssinian Robin Hood; when in rebellion he was always where he was not expected, and never to be found where he was "wanted." He seemed to have a most wonderful system of espionage in the camp of Dejatch Oubi, who then ruled Tigré by conquest. He not only made successful dashes on the enemy's troops, cutting off detached bodies and supplies, but when nothing of the sort was to be done, used to play tricks on Oubi and his chiefs, as if for mere amusement sake, or to keep them in a state of nervousness.

Once a General of Oubi's, at a feast in camp, ridiculed the Balgadda, saying he could not be called a General, as no one could tell how he could command an army, and sneering at the feats for which he was so much celebrated, comparing him to a kite, which dashes on its prey, seizes it, and is off again; boasting also of the great things he would do if set to catch him. All this passed in the Amhara camp, and doubtless the boaster never dreamt that it would reach the Balgadda's ears. One morning, however, on awaking, he found that in spite of guards and watchmen some one had entered his hut during the night, drunk up the mead that stood by his bed, carried off two favourite guns, and left a drawn sword across his bed head. Strict enquiries were made among the soldiers but no one could guess whom to suspect of so daring an act. The theft became a nine days' wonder in the camp. A few days after, when the matter had been well talked about, a countryman (Araia himself in disguise, it was said by some people) asked to see the General, and returned him his guns wrapped in a bundle of cotton cloth, with a note from the Balgadda, complimenting him on the quality of his mead, but not on his watchfulness, and begging him to send him back as a present one of the guns, which he returned, though he had every right to keep them, as taken from an enemy.

The other two chiefs were, oddly enough, the two men whom I alluded to as throwing a lance over the great tree at Axum: Desta and the Nebrid Welda Selassey. Both had the reputation of brave leaders in the fight. Desta being taken as a rebel, was sentenced to lose his

right hand. The operation is performed with a soft iron knife, rudely sharpened on a rough stone or file. Desta coolly spread his fingers to make the operation easier, and allowed his hand to be sawn rather than cut off at the wrist, without flinching or showing the least pain in his calmly smiling face. When it was off, he took it up in his left hand, threw it at the chief who presided, saying, with the utmost coolness, "See, I have still a hand with which I can cast a lance," and then, with as little hesitation as if about to wash, thrust the stump into a vessel of boiling butter provided for stopping the hæmorrhage.

The case of the Nebrid Welda Selassy is too horrible to relate, but he bore it with the same stoic fortitude. Though, being old, he died shortly after. But these are nothing to instances I have known, where blacks, beaten in battle by the Abyssinians, have lain down shamming dead, though unwounded, and submitted to the most horrible mutilations without giving the smallest sign of life. I cannot look upon this sort of physical endurance as a question of courage. It is more the habit of not believing in it. Men get as used to the notion that pain is only painful when it produces inconvenience, as "eels to skinning," or epicures to the belief that Epsom salts are nasty and olives nice. It's all habit. I remember a great big Galla coming at me with a club when I was unarmed. I stopped his blow and countered him, English fashion, under the left eye. Two things surprised me; first my blow produced a lump like an egg; secondly, he did not get up again, but squatted on the ground, crying like a child, and going through his war boast: "I have killed Shangalla, two men at such a battle! one man at such another! &c., &c., &c., and here I am dying of medicine!" If I had fractured his skull with a club, he would have thought nothing of it, but to be knocked down with nothing was impossible—it was "magic."

But the most singular case of a brave man becoming a coward when out of his element, that I ever witnessed, was that of a Bedouin chief, one of the bravest men, in his own desert, that I ever met. In his almost boyhood he had been left with two other youths in charge of the camp and women, while the men of the tribe went to water the flocks and herds at some distance. A party from a hostile tribe seized the opportunity and fell on them, the two other lads were at once killed; my friend Ali, severely wounded, scratched a line on the sand, intimating that he would not quit the mark, and fell on it, almost hacked to pieces, just as a party of his own people returned unexpectedly. He recovered, as a desert Arab only could recover, and years after, when I stayed with him, I could not only wonder at his wounds, but had many opportunities of seeing his cool daring when hunting or scouting alone with him among the hostile tribes on the frontiers of Darfour. His tribe had kept in the desert out of the way of the Turks, and so had shirked their tribute for two years. The season had been very dry, the cattle wanted pasture, and they dared not go down to the Nile, lest the Turks should make them pay their arrears tenfold, and punish them besides. So I proposed to take him to Dongola with me and intercede for him with the then Governor, Moussa Pacha, whom Sir S. Baker abuses so much, but who was a very dear

friend of mine. The moment the Beddawi got into the clearings he was another man; he could hardly speak, or eat, but sat cowering, with his cloth over his head, like a woman. He was afraid of houses, of boats, of small-pox, of everything he saw, but, most of all, one dark night, when we were poking our way to a village through a fog, of some unknown animal which, roaring in the most unearthly tone, kept just ahead of us. He thought it was the evil spirit leading us to some unknown, and, therefore, terrible fate. Had the devil appeared as a roaring lion, he would not have minded him in the least; the roar was unlike anything he or any of our party had ever heard. It was, as we discovered on our safe arrival at our destination, that of a very old she-ass suffering from a severe cold.

Dejatch Carsai, known in the Expeditionary Force as the Prince of Tigré, is a good horseman, and in his youth even, was remarkable among his countrymen for courage, yet a gentleman present tells me that his abject terror on being treated to a ride on one of our elephants, was something too ludicrous to conceive.

An Abyssinian battle generally begins by a few horsemen galloping out from one army towards the enemy, brandishing their lances and shouting their war cries. As they approach, a party twice their number meets them; the first comers throw a lance or two and turn tail as hard as they can, till they meet a still stronger party of their friends coming to assist them, then the pursuers turn and are pursued, and so it goes on with very few casualties, till something occurs; a great chief is accidentally shot, or taken prisoner, tipsy or asleep, by a party that has managed, unperceived, to turn his flank; on which his army is seized with helter-skelter panic, and then the real business of the "splendid cavalry" begins. They pursue and murder the fugitives for miles, for the sake of obtaining trophies, not unlike the Red Indian system of scalping. Many instances have occurred within my knowledge, of soldiers having murdered their comrades or poor peasants for the sake of these proofs of valour, which are exhibited to the King or chief at a great feast after the battle.

This boasting scene is very wild and picturesque, and very like what Catlin describes as "counting their coups," among the Red Indians. The chief sits in state and each successful soldier in turn stalks before him dressed in all his finery. At first he begins quietly, strutting backwards and forwards, brandishing his lance and repeating his master's name, war-cry, and the colour of his horse; then describing himself and his lineage, gradually works himself up to a sort of phrenzy, in which he stamps about, screaming all that he has done for him, how many men he killed on former occasions, naming each battle, and ending by throwing down the trophies taken in the last action, and bowing low before his master. The chief rewards each man according to his merits and rank, with gifts rising from a silver bracelet, a sword, or a horse, to a government.

I have witnessed cases where trophies had been gained by foul play which, being discovered, unknown to the perpetrator, he was allowed to go through his boast with the rest, receiving his deserved reward instead of the one he hoped for. But though I have published

one or two instances of such summary executions, in a book where they may be skipped, I refrain from giving them on the present occasion.

The great difficulty in describing to civilized people the manners and customs of savages is, that one is unable to tell the most singular and striking differences between their customs and ours, without relating what might shock one's hearers. On the other hand, if one confines oneself only to matters in which they do as we do, the narrative must of necessity be dull. I could relate frightful scenes of barbarous cruelty. I have said enough, however, to show that they are cruel, according to our notions, in punishment. I may add that they are the same in extorting money from the peasantry, on any pretext whatever. It is sufficient to be rich to excite suspicion, and suspicion once aroused, a pretext is soon found for a prison, with an iron bracelet, which, used as an instrument of torture, is periodically hammered closer and closer, till, if the sum required be not forthcoming, the prisoner is maimed for life, which often, under the circumstances is not of long duration. The minor chiefs and detached soldiers quartered on the villages carry out the same system in a small way, to procure for themselves what they choose to ask for. But it must be admitted that however hard they may have been themselves, almost all the princes I have known or heard of, from Oubi to Theodore, have been most ready to punish in the severest manner any outrages by the common soldiers on the peasantry.

Murder and violent robbery are by no means common, except in the legitimate way of making war on one's own account; and this is the more creditable in a country where a man can often in a few hours slip over the frontier and place himself out of harm's way.

Civil disputes are settled in a singular way, before the district chiefs, with appeal to the supreme chief.

They have a sort of self-taught counsellor, who is called a "Magwatch," but who is neither educated for the profession nor called to the bar, but is merely an ordinary man with an extraordinary gift of the gab. These men are sometimes employed in heavy cases, but not otherwise, as almost every man in the country is more or less gifted in that respect. If two persons have a dispute on ever so small a matter, one, getting excited, proposes to refer it to the Chief, a servant of whom, is at once sent for. He ties the corners of the disputants' garments together, and holding the knot in his hand, walks between them, first adjuring them by the back of the King, and by that of the Chief, that neither speak by the way. To disobey this order is a forfeit of not exceeding nine dollars to the Chief.

Arrived before the Judge, liberty of speech is given, and the servant still standing between them, the accuser begins by binding his opponent under the same penalty not to speak, or advance foot, or raise hand till he give him permission. It is rather hard for a hot-headed man to hear himself abused, and what he believes to be false, stated by his enemy; but unless he would pay the fine, he must do no more than give vent to his feelings, as he is allowed to, by grunting "Em! Em!" which he does in every imaginable variety of tone.

or some hereditary secret, a sorcerer. They are supposed to be able to turn themselves into hyænas, or other animals, at pleasure, and also to afflict and often kill people who may have offended them, by merely bending a straw and placing it, with some cabalistic words, under a stone. I have seen many very curious instances of persons so afflicted. The usual symptoms are dulness and refusal of food, followed by an apparent insensibility to pain or shock of any sort; the patient will on no account allow his or her thumbs to be taken, holding them tight in the hands, and has an irresistible desire to slip away unperceived whenever the hyæna's voice is heard. The bystanders suspecting the cause of the malady, procure charms, which are usually bits of herb and hyæna's fur, stitched in leather On the approach of a powerful charm, the patient, hitherto, perhaps, lying weak and helpless on the ground, starts up in a phrenzy, and struggles with such strength, that it often requires two or three strong men to hold even a woman. The charm forces the Bouda to speak, which he does in a language unknown to mortal men, till forced by the talisman to speak plainly, to declare his name, and at last to quit.

Among other pictures kindly lent to assist me in this lecture, I see one referring to an old story of mine, of a woman who was turned into an ass by a Bouda. The old woman died and was buried. After her burial a stranger came to the priest, offering a sum of money for the body, and promising secrecy. The priest was tempted, and the stranger went off with his purchase. The stranger, a blacksmith, was in the habit of passing the old lady's house on his way to market. After her death it was observed that he rode or drove a remarkably fine donkey, which oddly enough, on passing the house or any of the old woman's family, brayed loudly. For a time no notice was taken of this; but at last one of her sons came to the conclusion, from a kindred feeling, no doubt, that the ass was his late mother, and she and her owner were taken into the house. Here the donkey's maternal affection showed itself most clearly, by her rubbing her nose against the various members of the family. By dint of threats and promises, the Bouda was induced to confess the truth of their suspicions, to admit that the old lady had never died, but had merely been put into a trance by him for his transformation purposes, and to take the necessary steps to restore her to her pristine old womanhood. The ceremony was nearly concluded, one foot only remaining asinine, when one of her sons, unable to contain his anger any longer, drove his spear through the wizard's heart. The old lady lived for years, and many credible witnesses have assured me they had often seen her hobbling along on a human foot and an ass's hoof.

The Tigrituya is another form of devil, which exhibits itself in the sufferer wasting away and craving for music, dancing, and every sort of finery that can be conceived. After enough of this has been procured to satisfy the evil spirit, he will consent to leave his victim, who is taken out on the day fixed to a lonely spot, where a large party with music and dancing is assembled. The patient, usually of the fair sex, joining with the rest. When he has had enough amusement, the devil signifies his intention to quit, by the patient taking off her finery.

bowing her head and kissing her hands in token of farewell. She then starts at a pace which few men can equal, but which she can keep up only for 50 or 100 yards, when she falls insensible. The devil is supposed to have left her at that moment, and a party of active young men, who have been prepared, coming up, surround her, firing guns and brandishing swords and spears to prevent his return.

After the patient has drank water, she pronounces for the first time her profession of Christianity, words which, if uttered by another in her presence before the devil's exit, would have produced the most frightful results. A sheep is then killed, and part of it, broiled on the embers, eaten by the friends, the remainder left to amuse the devil if he should return to the spot. In this custom, and in that of passing animals round a sick person's couch, and then slaughtering them, we have traces of Jewish sacrifice. I have occasionally detected shams in these matters, but quite as often have seen or known of the sufferers dying while going through the absurdities I have mentioned. And it has often struck me as singular, that people should undergo so much suffering for no particular purpose, and still more so, that parents and masters, who themselves have been real or pretended victims, should put themselves to a great deal of inconvenience, and loss of the services of their children or servants for many days or weeks, if their own experience tells them it is a mere sham. I may refer any one who is spiritually disposed, to full details of these and other similar matters in "Life in Abyssinia."

The Christian element in Abyssinian Christianity is chiefly to be traced among the Churchmen, in their extraordinary fondness for schisms and theological disputings, and among all classes, in the numberless saints, whose names are continually in the mouths of the people. If fasting be of great avail, then no Christians are so Christian as the Abyssinians, for they have 154 days beside Wednesdays and Fridays, in all 258 days in the year, on which they may not touch food or water till late in the afternoon, and then only such wretched vegetable food as their country affords. Beside these regular days, a man must be very good who has not several more fasts ordered as penance by his confessor. However, they to a certain extent make up for this fasting by a great number of feasts which, the priests setting the example, generally end in riotous debauchery.

The Abyssinian's house is a low, circular mud and stone wall, with an opening for a door, and a conical roof of boughs and thatch. The only difference between the dwellings of the rich and the poor, is that in the country, the rich man has a greater number of such huts in his compound. In the towns they are sometimes made very large, and with an outer circle, which is divided into apartments, kitchens and other offices, sometimes square with a nearly flat roof. Lime is not used, and believed not to exist in the country. I have heard Europeans assert as much, but I feel persuaded that it is a mistake. The furniture of all houses consists of a rough stretcher or couch, the seat of which is formed of strips of raw hide stretched, crossing each other; a mud sleeping place, a few tanned hides, a wicker table, some

horns stuck in the wall to hang shield and lances on, and a number of sun-baked jars for corn and mead.

The Abyssinians are simple feeders. They have not, as a general rule, a chance of being otherwise. But when the chance occurs, they make up for lost time. Meat is a luxury, confined except now and then as a treat, to the upper 10,000. The poorer classes live chiefly on a spongy sort of cake, very much like a thin, but enormously large crumpet, of a dark brown colour, sourish and gritty to the taste, and made from a small dark seed called teff, or another called dagousha. This they swallow by aid of a mess made of ground lentils and boiled butter, and spiced with a fearful quantity of capsicum and onions, or with sour milk flavoured in the same way. They knead pieces of the cake into the sauce, and form it into pellets, like sausages, which they thrust into their own, or, if politely disposed, into their neighbour's mouths. To be much esteemed is to be three parts choked, and till accustomed to it, to suffer the loss of the greater part of the skin of your tongue and palate.

The feasting on raw beef is too well known to need much to be said on the subject. The animal is slaughtered at the door, and the flesh brought in while still warm (each particular cut being taken off by one man as fast as the skin over it is removed by another), and carried to the guests, who are squatted on grass laid down as a carpet round low tables covered with piles of the large cakes I have mentioned. The raw beef in great lumps is offered to the guests in succession, according to rank, by a servant who holds it in both hands, while the guest with his sword cuts off a long strip from the part he likes best, dips the end in a sort of capsicum paste, resembling chatny, and, holding it between his teeth, cuts off his mouthful by an upstroke of his sword close to his lips, and much endangering the tip of his nose. Mead and broiled meat are served after, and the feast goes on for hours. I should be afraid to say how many pounds of raw meat I have seen and heard of being eaten at one feast, and there is not an Abyssinian who, being in tolerable health, will not go to three or four such feasts, or more if he can, in one day. These feasts are usually on saint days, marriages, funerals, &c., &c.

When I say marriages it must not be understood that marriages are binding. The ceremony consists in a large number of the friends of both parties assembling. There is a great deal of dancing and raw beef, kept up for a night and a day. The bride has for her dowry twice as much as the bridegroom settles, and the marriage can be dissolved at any time by a division of the property so arranged. Some old people think it well, if they have lived long together, to go to church and take the Sacrament. But this is rarely done till the close of life.

There are many curious customs attending marriages, funerals, &c., but these cannot be given in detail in the limits of a paper.

I had intended saying something about the natural history of Abyssinia, but I find that I have already exceeded the time allowed me, and, in truth, on such a subject one cannot say much in a few words.

Almost all the beasts and birds described in Southern and Western

Africa are to be found more or less abundantly in Abyssinia and the neighbouring countries. Antelopes, grouse, and the smaller game of all sorts may be had in Abyssinia Proper, but a mountainous country is not to be recommended for large game. The best country I know for the sportsman is the district described by Sir Samuel Baker in his "Nile Tributaries of Abyssinia," a large country, or several countries, lying north of Abyssinia, and forming the southern boundary of the Soudan.

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Evening Meeting.

Monday, May 25th, 1868.

W. STIRLING LACON, Esq., in the Chair.

NAMES of MEMBERS who joined the Institution between the 18th and 25th of May, 1868.

LIFE.

Hay, James Francis Dalrymple, Lieut. Royal Ayrshire and Galloway Mil. 6*l*.
Scott, William, Lieut. R.A. 9*l*.

ANNUAL.

Pym, Samuel, Lieut. R.A. 1*l*.
Stevenson, R. A., Captain R.A. 1*l*.
Wickham, John, Capt. Hants Mil. 1*l*.
Lennox, Lord A. C. Gordon, Lieut. Gren. Guards. 1*l*.
Hardy, Chas. G., Lieut. Gren. Gds. 1*l*.

CIRCULAR SHIPS OF WAR WITH IMMERSED MOTIVE POWER.

By JOHN ELDER, Esq.

IN adopting the title selected for the paper I am about to read to this meeting, I think it right to premise, that whilst some results of recent experiments made by me are of considerable interest to the naval architect and to others engaged in those branches of scientific investigation and practice into which enter the consideration of the values of forms and the different properties of solid bodies designed for floating in and being propelled through fluids, and are, I think, likely to prove of sufficient interest to merit special consideration, they could not be properly treated of in the present paper. I hope, however, to be permitted during the early part of the next session of the Royal United

Service Institution, to lay before you, in the form of completed and well digested results, what I believe will prove of interest to the members of this important scientific Institution, and to scientific and practical men generally; when probably they may assist to make clear much that has hitherto been but imperfectly understood in connection with the development of the "theory of the forms of "least resistance," the resistance of bodies passing through "fluids," and other subjects under which such matters have been treated of by the various theoretical writers and scientific experimentalists who have flourished during the last and present centuries. On the one hand, I do not pretend that any great discoveries have been made by me in connection with the investigation of the present subject, or that I am going to revolutionize the whole practice of naval construction, and demolish the entire fabric upon which the construction of ships and the education of their builders have hitherto been based. It must, however, be clear to the minds of every one present, that naval construction is now in a state of transition; that much that has been done upon which the national wealth of this country has been enormously lavished with most unsatisfactory results, is entirely due to a want of that exact knowledge which belongs to other branches of science, and which should (and might) guide the professors of naval architecture in their teachings. It is to be hoped that ere long, practical men will be so well instructed by these professors that they may be able to follow their legitimate avocation of constructing and manufacturing for profit, without engaging in direct or indirect conflicts with natural laws, or producing unsatisfactory and undesired results, which needed not the surroundings of scientific theories for their production, but might have been equally well obtained by the old practice of the "rule of thumb."

I think it also right to premise, that the occasion and the shortness of the time at our disposal induce me to believe that the opportunity now afforded will be best availed of, and employed most to the satisfaction of my hearers, if I avoid all scientific speculation, and theorising; I will therefore confine myself to the briefest explanation of the subject of the present paper, and to describing the various illustrative diagrams, &c., suspended on the walls, leaving the more time for that which to my mind is the most valuable and useful result of such meetings as these, viz., the discussion which is evoked by the reading of papers. I wish to do this especially this evening, as I am favoured with so distinguished an audience, amongst whom I perceive many gentlemen of the highest eminence connected with the several branches of "*l'art naval*," the Commanders of our ships of war, the designers and constructors of the fleets of the past and present, and some who claim to be scientific designers of the "fleets of the future." I will therefore at once proceed to describe my "circular ships of war with immersed motive power," confining myself as closely as possible thereto, and avoiding the use, as far as possible, of all technicalities—as well as of scientific terms, speculations and theories—leaving, no doubt, much unsaid in the course of the reading of the paper, but the more to be evoked and eliminated during the discussion which I trust will follow.

Circular Ships.

I do not in this paper propose to enter upon the question of the suitability of circular ships as sea-going, passenger, and freight-carrying vessels, but intend to limit myself to their applicability for sea-going ships for coast and harbour defence, and may also, if time permit, point out their superiority, general usefulness, and infinitely smaller cost as compared with stone forts constructed in estuaries, channels, and rivers as most important national questions; also their capability as floating platforms for fighting guns of the largest possible calibre with the advantage due to the greater stability and steadiness thus attainable, and their suitability for carrying monster mortars, permitting of the discharge therefrom of shells of greater size, and containing larger explosive charges than heretofore, and with an accuracy never hitherto obtainable in firing from a mortar ship. Beyond, or in addition to these comparisons with existing ships or vessels of war, and with fixed or built forts, I propose briefly to call attention to what for the first time has been possible in connection with naval attack, and which is essentially novel and peculiar to this form of vessel—the peculiar manœuvring powers of which they are capable, and the formidable character of such vessels when so used or employed against an enemy's fleet. I am aware that circular structures have heretofore been projected or proposed as floating buoys and beacons, such as those of the late Mr. Herbert, the late Mr. George Rennie, and Mr. Oldham, of Hull, and all the floating lights, beacons, batteries, and other vessels of Mr. John Moody, of Goole, which are not circular, either on the plane or in the vertical section, but, as described by Mr. Moody, in the specification of his patent, are "of "starlike form, with four or other number of arms," and he adds, they are to be made "with a flat bottom, and over it is a deck, arched in all directions." Of course any of these last described structures might be fitted with steam power, but it is self-evident that neither of them are designed to be used or employed as steam propelled ships of war for naval attack, nor are they capable of being moved but at very low speeds with the expenditure of great power.

Circular Ships intended for the purpose of Naval Defence and Attack.

I believe it has been generally conceded by the highest professional authorities amongst the commanders and fighters of our naval ships, that the turret or circular, or "all round" system is the handiest and best, the handiest for working heavy guns, and the best form for resisting shot. The question naturally suggests itself what is the best form of vessel in which a turret may be carried?

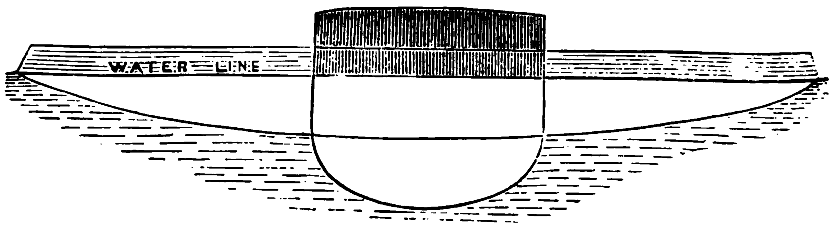
Whilst studying the questions of turret-carrying and gun-fighting, it occurred to me that there still remained another mode of dealing with these questions, namely, that of making the turret carry itself, as it were, or in other words, to make a vessel perfectly circular on the plane and the vertical section representing a small portion of a circle, and the

frame lines of which should all radiate from a common centre, so that any section taken across the diameter would be similar to any other section taken on any other line passing through the common centre, or to use a familiar illustration, to make the shape of the hull of the vessel like a slice cut straight off an orange, the skin representing the skin of the vessel. See Plates xxiv and xxv.

By so constructing a vessel it would be able not only to travel in a straight line in any given direction, whether forward, backward, or angular, but it would also be able to revolve with great facility while so moving or when stationary, but without the use of revolving gear or mechanical apparatus liable to the contingency of becoming jammed; and the turret also might be enormously increased in size, and be capable of carrying a proportionately larger number of guns and mortars of colossal dimensions with perfect safety.

After making some experiments on the resistance offered by various circular forms of vessels in passing through water, I found that the immersed portion of a vessel having for its outline a small segment of a large sphere, so that the vertical or buttock lines were very fine, required no more power than would have to be exerted in order to make an ordinary iron-clad vessel of war, of the same displacement, travel, or move through the water at the same speed. Thus, upon making two models, one of the ordinary form, and one of a circular vessel of equal displacement, and towing them at the same speed through the water by means of a line, having a scale-beam or yoke, interposed, the tractive force upon each tow line attached to each end of the scale beam, being the same, I found that the yoke (or scale beam) interposed between the towing boat and the vessel being towed, was constantly at right angles to the line of forward motion, so that the resistance offered by each vessel was practically the same in each case.

This result will be readily apprehended or understood when it is shown by the accompanying diagram illustrative of the two cross sections,



that the circular model has a much lighter draught than the other, in fact the circular model drew a little less than one-half the depth of water, whilst the breadth of the section is greatly increased, as will be hereafter referred to and explained more in detail.

I may here observe in a general way, that these experiments have thus far proved what might not perhaps have been expected, that there is no reason why a vessel of the same displacement, as one of

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1.

Fig. 2.

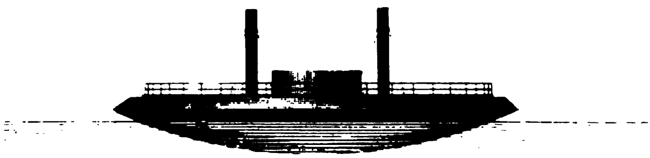


Fig. 3.

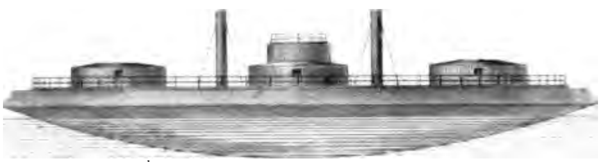


Fig. 4.

Fig. 1.

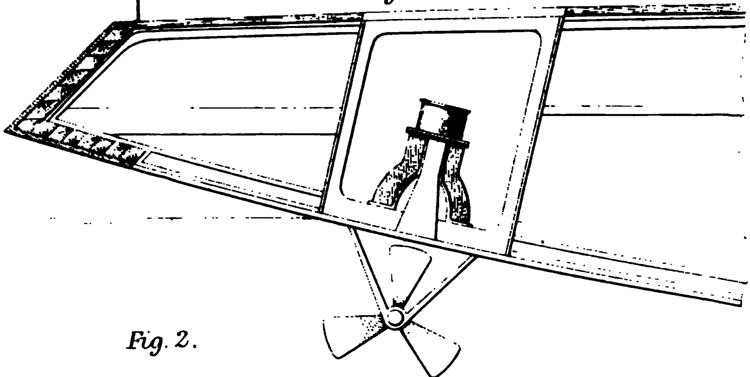


Fig. 2.

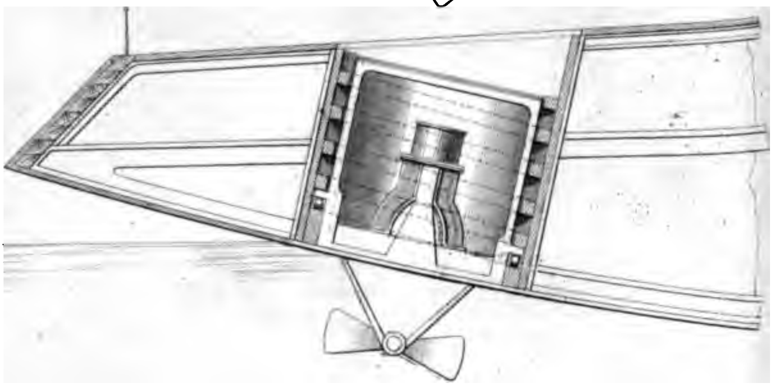
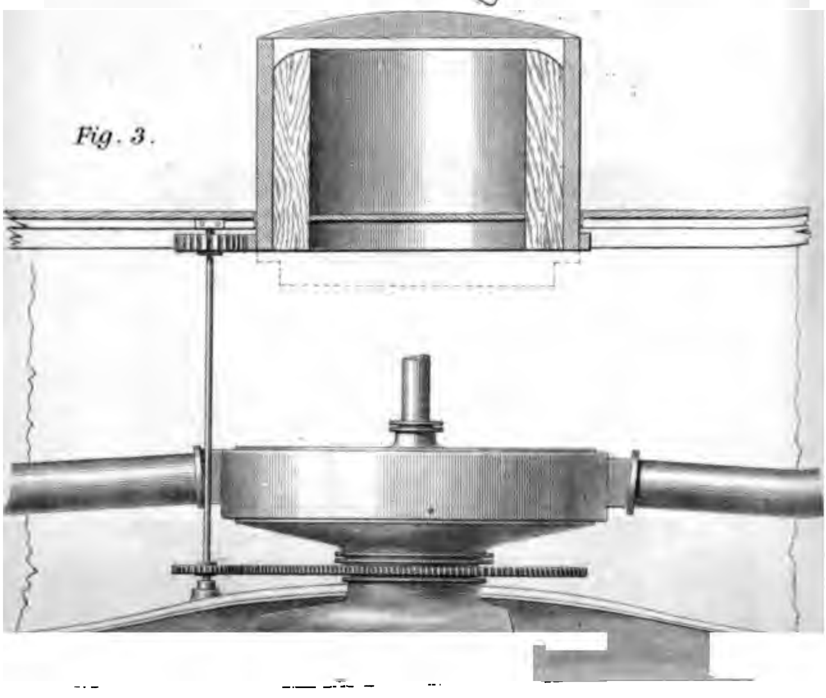


Fig. 3.



t iron-clads, but circular in form, may not be propelled at an high rate of speed, whilst from the very light draught of the ship, it would be able to approach and enter many places at pre- ite inaccessible to our large vessels as at present constructed.
o found, as might perhaps have been expected, that the circular vas much drier and a better sea boat in rough weather than the y model, and its immense superiority as regards stability is itly obvious to render unnecessary any remarks upon that of this subject.
llustrate the modes of propelling, I have shown in one of the ns (Plate xxvi) several ways that might be employed, such as one or more screw propellers supported by brackets (Figs. 1 and 2), o the outer skin of the vessel. Another method might be l in which a casing or trunk is formed, so as to admit the shaft, and the screw shaft being carried sufficiently low down, enable the propeller to work in unbroken water. I have also a plan with a water jet propeller (Fig. 3).
circular vessel from its form, and the very nature of its con- on presents an admirable opportunity for placing in the most position the machinery and apparatus necessary for trans- and communicating motion to the propeller, as well as for ling and manœuvring the vessel whilst in motion, it also peculiar advantages for adapting the turbine or emissive jet er over any other form of vessel heretofore designed.
refore proceeded to arrange and adapt the hydraulic propelling us to my own requirements, and as it will be seen on reference drawings (Plate xxvii, figs. 1 and 2), nothing can be more compact venient than this adaptation. By this means the contour of the may be preserved unaltered, and it is consequently perfectly travel in any direction, or to revolve fly-wheel-like with the t possible expenditure of power, there being no projecting parts es either of machinery, gearing, or casings to impede the vessel's ent.
der that the efficiency of the vessel as a war-ship should be veloped, it is necessary that it should be capable of manœuvring e utmost possible rapidity, or that it should be capable of the direction of its motion or movement changed from right to reversed, or be capable of revolving or pivoting without difficulty of time. In our long build of broadside-battery ships of war, about after firing one broadside to discharge the other, is a involving an immense sweep in distance travelled, a vast iture of power, and a considerable loss of time, whereas, I fore- at I might accomplish the object so much desired by every actician and artillerist, by bringing the whole of the guns under mand to bear upon the object of his attack with the greatest in any required order of succession, without any longitudinal al—in fact without any linear-movement at all of the vessel or tform; this at the same time possessed a stability and steadi- hich no existing form of floating battery or other ship of war sibly possess.

Now, for the purpose of effecting the object sought to be attained, I designed the peculiar arrangement of machinery and apparatus which I have shown on an enlarged scale in a transverse vertical section and plan in Plate xxviii, figs. 1 and 2. Upon reference to these views, it will be seen that the machinery apparatus consists of a large turbine or horizontal centrifugal pump, the vertical axis of which is in the central line or axis of the circular ship, and the spindle, or driving shaft, forming the axis of the turbine or pump is rotated at the requisite or necessary speed by means of a steam-engine or engines in the usual way, and is capable of being set in motion, or it may be stopped readily either by the stopping of the engine, or by disconnection, or throwing out of gear by means of a clutch or other convenient apparatus.

For the purpose of causing the vessel to travel in a right line, or of changing its direction of motion at any angle from the line at which it was previously moving, and also for the purpose of giving a compound movement to the vessel whilst in motion, and also for the purpose of rotating the vessel about its own centre, either whilst the vessel has no forward or backward linear movement, and for producing a compound rotary and onward movement, I have contrived several simple and effective arrangements of propelling apparatus, some one or more of which, I propose to describe in connection with the employment of a turbine or centrifugal pump as before mentioned, and shown in Plates xxviii and xxix.

One of the arrangements which I have shown for effecting these various movements is, that in which the outer case or shell surrounding the turbine has four openings, and communication by means of large pipes between it and the water, in which the ship is floating. These pipes are placed at right angles to one another, and each pipe is increased near the turbine to double the area, and is divided horizontally by a web, as shown in the sectional view (Fig. 1, plate xxviii). At this point a valve is placed, and this valve is free to travel vertically, so that when lowered, it shuts the water off from the bottom division of the pipe, but leaves the upper division of the pipe open, and thus when it is raised, the lower division will be open, and the upper one closed, and when placed at half the length of its travel, it would shut off all communication between the turbine, and the external water, and so check the inflowing or outgoing, or admission or emission of the water.

The turbine itself is shown as similarly divided in two parts, my intention being that the lower half should be employed for a suction or indraught, and the other half for the delivery or emission. Now for the purpose of illustrating the action of this propelling apparatus, I will beg your attention for a few minutes to the several parts illustrated in Figs. 1 and 2, plate xxviii.

Now, supposing that the two cross pipes, C and D, are entirely closed, and that the valve in the pipe A is raised to its full extent, and the valve in the pipe B lowered, the turbine will have its lower half or suction open to the water through the pipe A, and its delivery or water jet similarly open through the pipe B, and consequently the

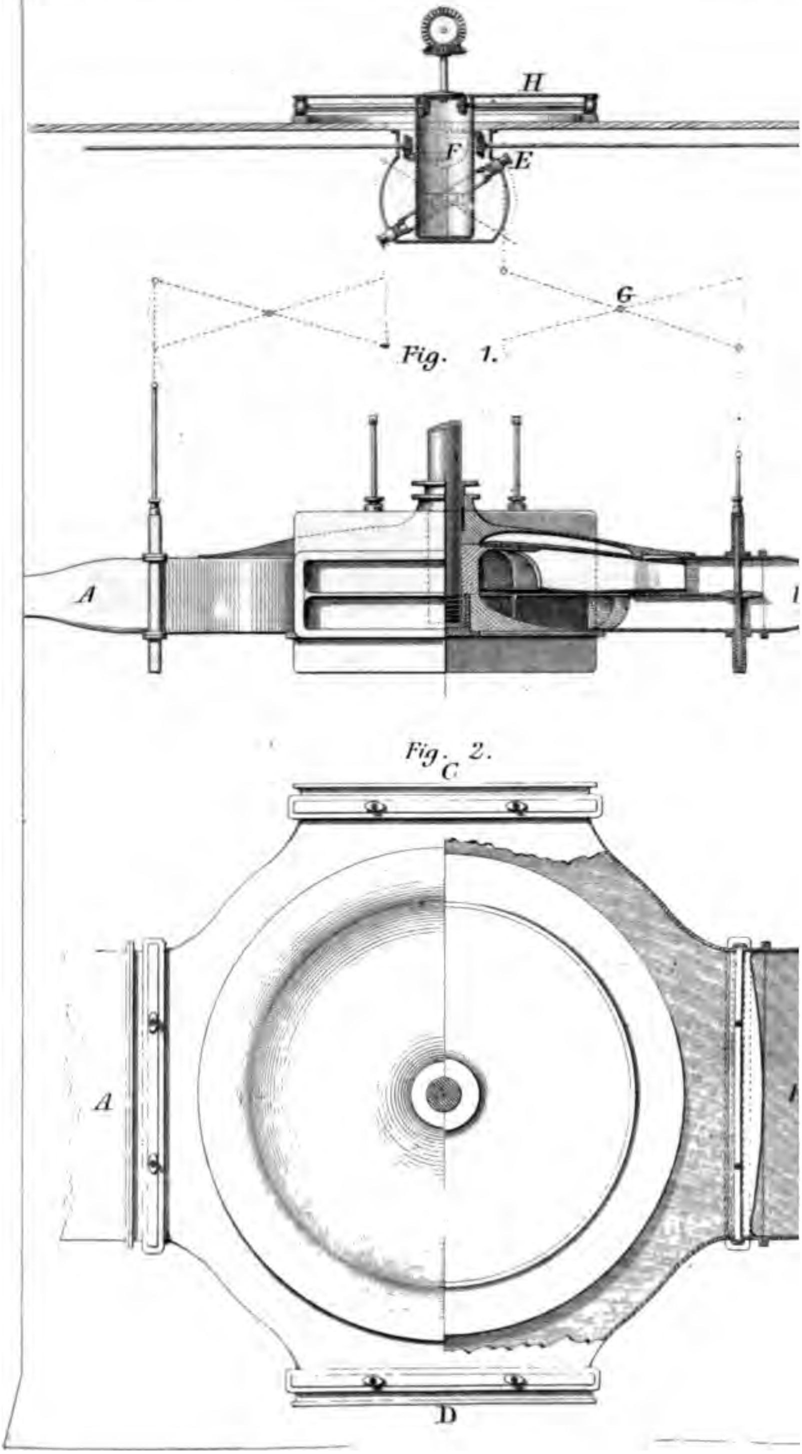

H
F
E
G
Fig. 1.
A
Fig. 2.
C
A
D

Fig. 1.

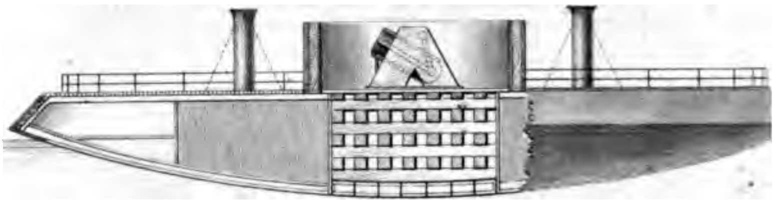


Fig. 2.

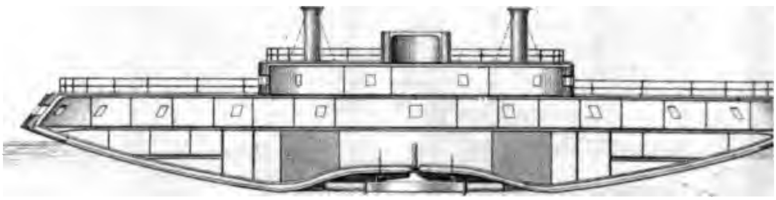


Fig. 3.

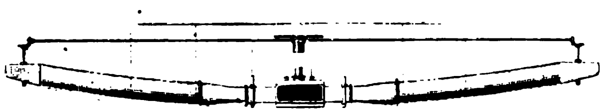
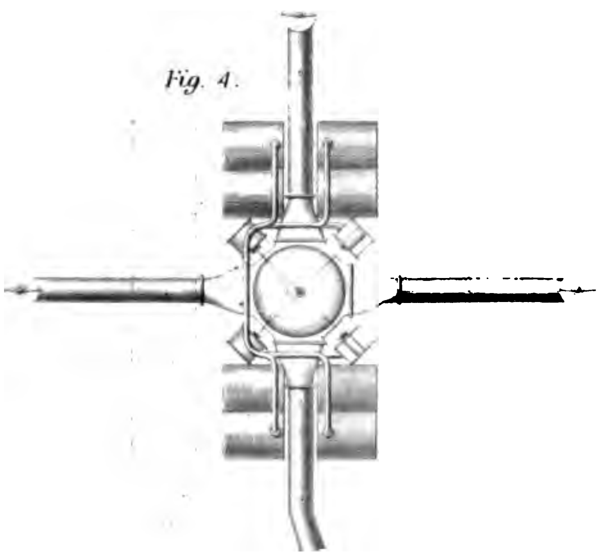


Fig. 4.



vessel would travel in the direction B A. If it were required suddenly to reverse the direction in which the vessel was travelling, it would only be necessary to lower the valve of the pipe A, and raise that in the pipe B. Again, by placing the valves of these two pipes A and B at half their stroke, all communication between the turbine, and the water would be closed, when by operating in a similar manner, as just described, the valves of the pipes C and D, a motion at right angles to the arrow in either direction would be at once obtained.

In order to actuate these several valves in connection with one another, they may be severally attached by means of suitable connecting rods and levers to a circular pulley or disk, E, Fig. 1, fixed at such an angle upon the drum, F, that the vertical distance of the highest to the lowest point is equal to the full travel of the valve, so that the valve B, that is attached to the highest point, is by means of the lever, G, placed in its lowest position, while the valve opposite to it, A, is placed in its highest position, the two other valves being both placed in their central position, of course entirely close the two cross pipes, C and D, and thus the vessel is now ready to travel in the direction B A.

Now, supposing the drum F is turned half way round, the valves of the pipe A will be brought to its lowest position, and the valve of the pipe B to its highest position, and consequently, as already described, the direction of the vessel will be reversed. In like manner, by turning the drum, F, a quarter of the way round only, the two other valves of the pipes, C and D, will be respectively at their highest and lowest positions, and the course of the vessel will be similarly varied. In order to vary the course of the ship in a slighter degree, or in other words, to steer it, balance-rudders (Figs. 3 and 4, plate xxix) are placed just at the end of the pipes and worked in the usual manner. A turntable, H (Plate xxviii), may be attached to the drum, F, and which will consequently revolve with it, so that a person standing upon this turntable with his back to the highest point of the angular pulley, and looking straight before him, will always be looking at the spot towards which the vessel is travelling, and thus by revolving the turntable and bringing himself when in that position to look at any particular spot in any direction, the vessel will travel towards it. By having a line drawn on the turntable, or by having a sight fixed in the proper line, the direction in which the vessel is travelling might be told at a glance, with the greatest precision. The whole of these valves may be worked by means of independent engines carried on the turntable itself, and the only manual power required would be to move a small handle, as from time to time may be necessary.

The vessel may be made to revolve by putting the rudders hard over, but if greater facility for revolving is required, curved pipes (Fig. 2, plate xxvii) would be used, in addition to the straight ones, already described, one being placed on either side of the straight pipe and the three being so worked by a valve that only one of them can be fully open at a time. It will thus be self-evident that if the water is taken through one of these curved pipes into the turbine, and delivered

by it through the opposite curved pipes, shown in dotted lines, so that the water travels somewhat in the form of the letter C, both the suction and delivery pipes are tending to force the vessel round. The vessel is thus enabled to travel in any direction, or to revolve by simply actuating the slide valves fitted to the respective pipes, and we have, therefore, a vessel capable of executing the most difficult manœuvres with the greatest rapidity. So much for the form of these vessels and for the mode in which I propose to move or actuate them.

Armour-plating for Circular Ships.

From the peculiar form of these vessels but little breadth of armour-plate will be required of any considerable thickness, as the whole of the lower part of the ship is inclined at such an acute angle with the horizon that it would be impossible to strike it injuriously except with a ricochet shot (see Plates xxiv and xxv).

The Form of the Upper Portion of Circular Ships, whether employed for the purpose of Attack or Defence.

The upper part of the vessel may be made of various forms (see Plates xxiv and xxv), thus the sides may be raised directly from the outer edge and sloped inwards so as to form a cutting edge round the rim of the vessel (Fig. 2, plate xxiv), and also be pierced for guns—a revolving pilot-house being placed in the centre from which the vessel is manœuvred, as before described, and as illustrated in Plate xxviii. The only heavy armour-plating required in this case is, as there shown, about 7 feet in breadth round the outside, and similar plating to protect the pilot-house.

Allowing the thickness of this armour-plating to be 8 inches on these parts and 3 inches on the lower angled portion for about 8 feet in width, the armour-plating would be about 2,000 tons in a vessel of 200 feet in diameter, with 13 feet draught of water, and capable of carrying 26 heavy guns.

As a modification of this plan, a second battery may be placed above this of smaller diameter, as shown in Fig. 1, plate xxiv, when the fighting power of the vessel would be increased by 10 guns, and the draught of water would then be about 14 feet. In Fig. 4, plate xxiv, is shown an elevation of another modification in the shape of the vessel. In this case there are no guns round the outer edge, but this part is made very sharp and immensely strong, and is meant to be used as a ram, or rather as a circular saw and ram combined. Thus, upon coming into collision with another vessel, a rotary motion may be imparted to it by forcing the water through the curved pipes, before described, which would then give the edge a combined ramming and cutting motion sufficient to make a very ugly gash in the side of the strongest iron-clad. The battery is intended to carry ten 300-pounder guns, and it is calculated that with proper appliances, a gun

of this size may be worked so as to fire once a minute; it would only be necessary to cause the vessel to revolve at that speed to deliver ten 300-pound shot against the same spot in the space of one minute. By having a "look-out" in the centre of this battery, with lines of sight accurately corresponding with the lines of fire of each gun, one man might, by means of lanyards, fire each gun as it came opposite the required spot, and thus the only training required to be done by hand would be for obtaining the required elevation.

Upon referring to the elevation, Fig, 4, plate xxiv, it will be seen that this vessel has the deck somewhat rounded, several advantages attaching to this form. In the first place it can be made very much stronger and better adapted for ramming purposes than is possible with a flush deck, the angle formed with the horizon by the plates above and below the cutting edge being about equal.

It would also be impossible to board a vessel with a rounded deck, while any water that might be shipped would immediately run off again.

In Plate xxvii, figs. 1 and 2, is shown a design for a still more powerful vessel, being 280 feet in diameter with 15 feet draught of water, and intended to carry 14 22½-ton guns, each throwing a 600-pound solid shot. In this case the vessel is intended to be manœuvred from a pilot-house above the battery, the arrangement for working the valves from it being shown in the drawing. Various other modifications, as shown in Plates xxiv and xxv, may be made, both in the external form or hull and also in the arrangement of the batteries. Thus the hull, instead of being a section of a sphere, may be in the shape of a truncated cone, which might in some cases be preferred. The vessel might also carry several tiers of guns and for some purposes, such as firing over the walls of a fort or high bank on shore, a turret or tower may be built to a considerable elevation (Fig. 1, plate xxv), the immense stability of this form easily admitting of such an arrangement.

The methods of propulsion, too, may be greatly varied; that shown in Fig. 2, plate xxix, being exceedingly simple. In this case the turbine is outside the vessel in a recess formed for the purpose. This turbine may be turned, by means of a rack and pinion, in any direction, while the same pinion-shaft carries at the other end a similar pinion-gearing into a similar rack attached to the pilot-house (see Fig. 3, plate xxvi), the turbine and pilot-house being turned simultaneously in the same direction. By placing an opening or look-out in the pilot-house, exactly over the suction of the turbine, the spot seen from thence, is the spot to which the vessel is travelling. Now, supposing the Officer in this pilot-house has the means, by the use of a small donkey-engine, or by any simple method, of turning it in any direction he pleases, he at the same time turns the turbine as well, and, therefore, by keeping any particular place in view through the opening in the pilot-house, the vessel will travel in that direction. He has therefore only to look at the object which he desires to approach, in order to enable the ship to be propelled directly to or towards it.

The Construction and Method of Building the Circular Ships, and their General Arrangement.

I propose next rapidly and cursorily to glance at these points, as the time allotted to me is now fast approaching its limit.

Construction.—The construction of these vessels is as simple as that of an ordinary iron ship, only that the frames and floors, instead of extending from keel to gunwale athwartship, radiate from the centre to gunwhale at the outer edge, every frame and floor being the same length and form (Figs. 1 and 2, plate xxx); this will greatly facilitate the erection of the structure.

These frames are thoroughly secured in their places by a series of circular keelsons or stringers, placed as deemed necessary. Beams may either be put in straight across (Fig. 1), or to radiate (Fig. 2) (the straight being preferred); the beams on one deck being placed at right angles to those above or below. The beams will be made in straight lengths of about 40 to 50 feet, secured with a long scarf plate, and thoroughly supported by a series of holds. The outside plating will be easily put on, as each strake of plates will have exactly the same "set and say." In some cases it may be preferred, instead of radial framing to frame the vessel with a series of circular keelsons or frames, and the stringers to radiate as the frames do in the first method described; this would answer every purpose just as well, but would be more difficult and expensive to erect.

Steering.—It is proposed to steer these vessels, either by means of ordinary rudders placed at the outlet of the propelling pipes, or by blade rudders similar to those used in the Indus flotilla boats (Fig. 3, plate xxvii), placed at an angle of 42°, fitted in water-tight wells, the one being lowered as the other is raised. Four such rudders would be sufficient for a vessel of this class, and all would be worked by one steering gear.

Bulkheads.—These may be placed in any position, and divide the vessel into as many compartments as may be thought necessary for safety.

Ventilation.—This is to be obtained by means of fans worked by donkey-engines, it not being desirable to have as great a number of skylights and hatches as in ordinary ships, and all openings should be made as conveniently small as possible, and fitted with armoured hatches of the same strength as the deck covering, so that when going into action, all exposed parts shall be of the same relative strength. A ventilator is fitted in the battery deck over each gun.

Mortar Beds.—These vessels are admirably adapted for carrying large mortars, on account of their great stability, and it is proposed to use them for such purposes by forming the mortar bed of a large area, and constructing the same of baulks of timber laid one on the other after the manner of a steam-hammer bed (Fig. 1, plate xxix), the upper portion of the bed may be fitted with a series of india-rubber buffers, or springs to assist in deadening the recoil.

Mooring.—It is proposed to moor these vessels by means of mush-

Fig. 2.

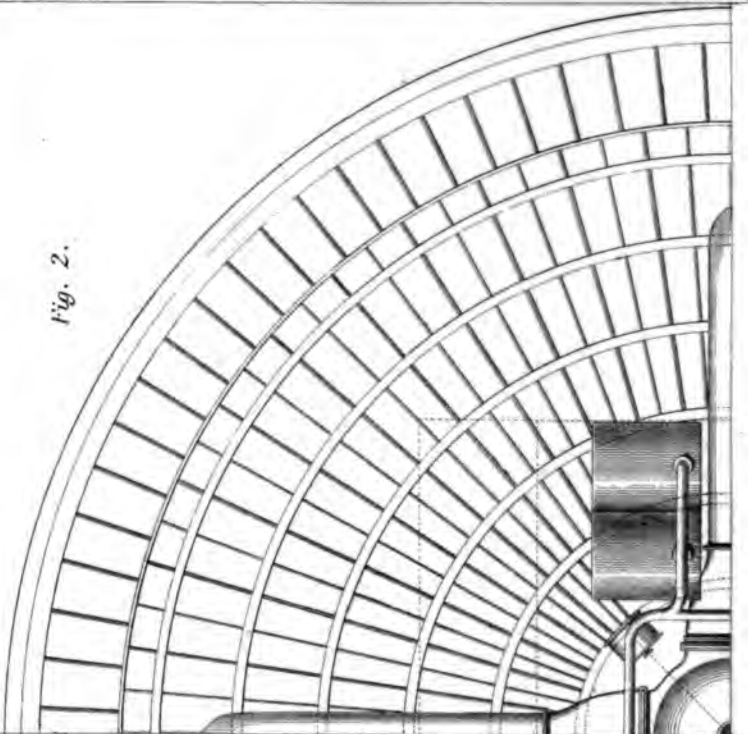
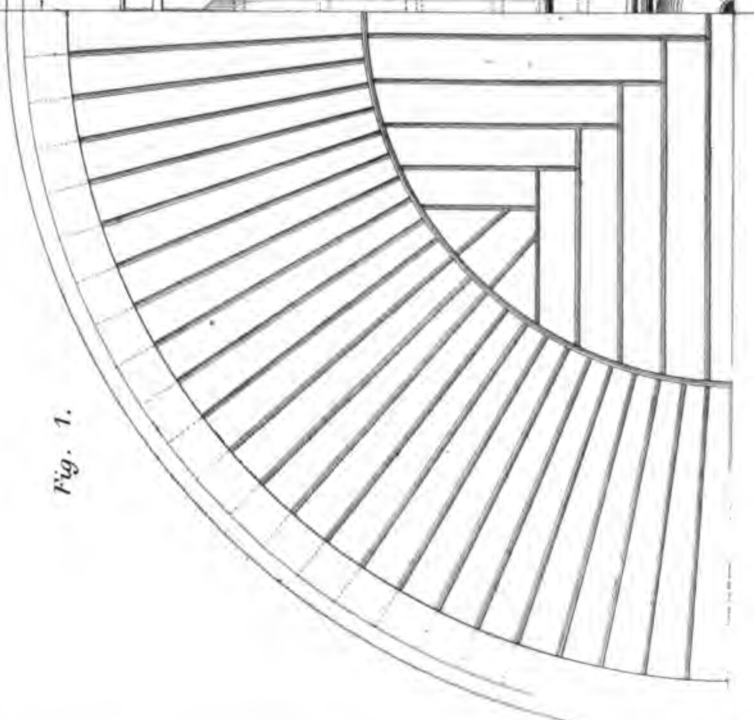


Fig. 1.



room or other approved form of anchors, worked by capstans, &c., in the usual manner, but instead of hawsepipes, catheads, &c., we lower the anchors through a well in the ship's bottom (Fig. 1, plate xxvii), and when the anchor is raised, the lower portion of it is flush with the outside plating of the vessel. The well is constructed of a sufficient size, and sufficiently high out of the water to introduce another anchor in the event of losing one.

Turrets.—For the turning gear, the plan usually in practice is proposed to be employed, but the principal object of fitting turrets to these vessels is for fighting the heaviest class of guns when the ship is at anchor, and the whole structure cannot revolve in the water as one turret afloat, until steam is got up. Another advantage is, that we may have these turrets higher out of the water than in ordinary Monitors, and so fire down on the decks of such vessels; but in some cases for harbour defence, we would propose low vessels carrying say four or more turrets as the case might be. In such a class, would be combined all the advantages of a "Monitor," and if need be a most formidable ram when underweigh.

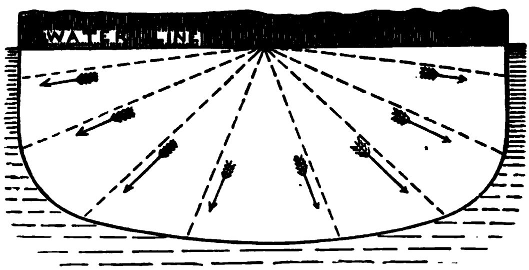
Ram.—Any portion of the armoured edge will act as a ram, and if the vessel is driven at any floating body, before coming in contact with the same, it is proposed by means of its peculiar machinery to cause the whole structure to revolve, which will deaden the shock on the circular vessel to a considerable extent, and enable it to act as a saw against the sides of its opponent, thus doing enormous damage.

Accommodation and Stowage.—Space for fuel is provided all round the central portion of the vessel occupied by the machinery and boilers, and may be of any capacity that is desired. Alongside of the coal-bunkers, so as to be directly under the battery, may be fitted either two or four magazines and shell-rooms, as may be necessary; these having water tanks on the top, and around three sides, with the bunkers on the fourth, will be secure in case of fire, and pipes may be fitted for flooding the same without injury to any other portion of the holds. I have shown in Figs. 1 and 2, plate xxvii, that the main-deck is divided into four segments by strong iron, water-tight bulkheads, and a circular collision bulkhead extending all round about 12 feet from the periphery. On this deck is provided ample accommodation for the Officers, crew, engineers, Marines, &c., in fact from the form of vessel, the amount of space for accommodation is more than will be required. Below are the holds fitted in the usual manner, with store-rooms, bread-rooms, chain lockers, boatswain's and gunner's stores, and all the usual appurtenances of a vessel of war.

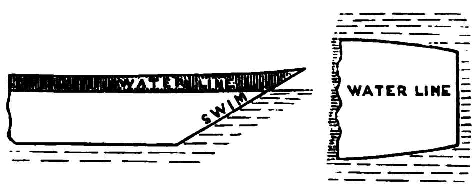
Battery.—Access is obtained to the battery from the deck below, and from its circular form great space and convenience is secured for working a heavier class of guns, and ample room is provided for the cranes, and all the usual gear and machinery for hoisting up heavy shot and shell.

Speed and Resistance.—As I have before stated, a circular vessel of any of the accompanying forms will offer but little, if any, more resistance to the water than vessels of the "Minotaur" and "Agincourt" class. The breadth on the water-line amidships for a vessel of

200 feet extreme diameter, we will take at an average to be 185 feet, with a draught of water in the centre of 14 feet, a displacement of about 7,000 tons, and an immersed area in square feet of about 2,100 feet. Our larger iron-clads—say the "Warrior"—are about 58 feet beam, drawing somewhere about 30 feet of water, which will give an immersed area, allowing for rise of floor and turn of bilges of about 1,500 square feet. Now, as far as this appears at first sight, the difference in area of midship section is greatly in favour of the "Minotaur" class; but at the same time, it must be borne in mind that the draught of water is more than doubled, and for every foot of immersion, the resistance to a moving body is immensely increased. Another matter to be duly considered, and a very important one, is, that all vessels only divide the water in accordance with the form of their water-lines, on and a little below the surface, and on their flat sides amidships, if flat-sided (this vessel has no flat side), from whence the water is displaced or driven under, as shown in the sketch. This



may be proved by examining a steam-yacht's bottom that has been newly black-leaded or painted, and not allowed to dry before making a run, when a number of wavy marks will be found in the direction I have named. Another instance in proof thereof is the swim of the ordinary Thames barge; the longer and easier "the swim," both fore



and aft, the easier is the barge in tow, or the faster will she sail. And I may mention, as a still further proof of this theory with regard to fine vertical sections, as influencing the speed and resistance of vessels, the fact, that when a well formed steamer gets underweigh, as she attains her speed so she lifts her bow out of the water to a

certain extent, and the old bluff-bowed vessel, or the vessel with fine water-lines and bluff forward buttocks (and there are many such), and with the vertical sections or buttocks much finer aft than forward, has the tendency to immerse her bow, instead of to rise, consequently proving that for speed, fine fore and aft buttock-lines are of the utmost importance when combined with the least possible depth of immersion. For example, the old "America" yacht, of A.D. 1851, had the finest fore and aft buttocks or vertical sections of any vessel afloat, good beam and light draught; consequently to these qualities is attributable her great speed. Now, with regard to the circular form of ships, it is evident that they have the finest possible vertical sections that can be obtained in any vessel, and putting these facts to weigh with shallow draught against the extra amount of area of immersed section and the fulness of the water-lines, it is evident that the increase of resistance is but of little or no importance, for it will be seen by reference to the first woodcut, that whilst in the circular ship the relation of breadth to depth of immersed sectional area is as 185 to 14, giving 2,100 feet, a ship of the ordinary form of the "Minotaur" class would have a breadth of 59 feet and a depth of 30 feet, giving nearly 1,500 feet

I have now occupied more time than I intended to devote to the reading of this paper, but I trust that this will not militate against the fullest discussion of the subject, which I now respectfully invite; and in conclusion, I shall be happy to answer any questions arising out of its reading, and which are in my power to reply to. If I am fortunate enough to have succeeded in occupying your time without wearying you with so unpopular a subject, I shall at least have done as much as many other abler men have done when they have undertaken the task of inviting public attention to a subject, the ultimate importance of which may not have been understood, and must not be measured by the unpreparedness of the public mind; and on any question which involves the judicious and useful expenditure of money for a specific and well defined purpose as against the lavish and injudicious outlay of money raised by national taxation in a time of national disaster and depression, such a subject as the present, although presented in so unscientific and popular a manner to so distinguished an audience, still merits for itself a share of public attention.

The CHAIRMAN: You have heard the invitation of Mr. Elder, and the hope he has expressed that the value of his paper may be brought out by the discussion that will follow. If any gentleman has any observations to make we shall be very happy to hear them, but I would suggest that any gentleman who addresses us should keep his remarks entirely to the subject before the meeting, and, in order that others may have the opportunity of taking part in the discussion, that he should confine himself to ten minutes. If any one has any questions to ask, Mr. Elder will be kind enough to make a note of them, and at the end of the discussion answer them in gross.

Admiral HALSTED: If you will permit me to say, just to break the ground for a very old friend of mine, for whom I have great esteem, that he must not be surprised if he has taken us all aback, when we have got to consider so utter and entire a novelty as that which he has brought before us.

Captain J. H. I. ALEXANDER, R.N.: I wish to ask what is the proposed manner of heaving the anchor up, for I see in one of the sectional plans the capstan on the

upper deck, which seems to me excessively exposed? not that I can see any difficulty in placing it below the water line, on the next deck. I would also ask what is the proposed thickness of the defence of the upper deck against a vessel high enough in the water to fire down on her? It seems to me that there is a very large space exposed there, and if it is proposed to give a very great thickness, of course it will add very greatly to the draught and tonnage of the vessel. Otherwise, while confessing that, like the gentleman behind me, I am rather taken aback, still I am very much in favour of the plan. It seems to me that, if it were possible to adopt the tortoise-shell form for the upper portion of the ship at an angle which would in all probability glance a shot off, it would be much more secure, and would be equally available for the purpose required.

Mr. ELDER: That is about the angle (showing the model).

Captain ALEXANDER: Even that model which you have there seems to me to be a very insufficient angle for deflecting shot.

Vice-Admiral ROBINSON, Controller of the Navy: The few observations that I was going to make are rather met by the observations that we have heard from the gallant Officer—that the plan before us is a matter of extreme novelty, and that we are rather taken aback by such a novelty. I confess that, having for a great many years of my life, in an official capacity, been dealing with novelties every day, and having been instrumental in advancing some novelties, not exactly towards perfection, but at any rate I hope in the direction of progress, I do not feel absolutely taken aback by the very novel proposition that you, Mr. Elder, have introduced, with great ability, to the meeting this night. I think, on the contrary, it is a proposal that we ought to consider most attentively, and we shall be glad to hear from you answers, which I have no doubt you are perfectly capable of giving, to many objections that must at once suggest themselves; I am sure they suggested themselves to your mind when you were contriving and inventing this machine or ship. The obvious difficulties and objections that must present themselves to any one like yourself, or like most of the gentlemen in this room conversant with the motion of bodies through the water, are in connection with that extraordinary midship section that you have got to deal with. I see before me a midship section, in a ship 300 feet long, I ought rather to say a circular vessel 300 feet in diameter, which midship section cannot be much less than 280 feet across at the water line. One of the ablest naval architects in Great Britain, to whom we all bow, who never speaks or never writes upon any subject without both enlightening and delighting us, Mr. Scott Russell, has said of a midship section, "the midship section of a ship is the thing that you have to drive." Now, I own, and I am sure you did when you first began to think and to consider this important subject, that I look with a little stupefaction at a midship section at the water line, which presents a breadth of something like 280 feet, to be pushed through the water at any velocity whatever. I observed you fell into a mistake of no very great moment, it does not affect your argument, in supposing that the "Minotaur" class draw 30 feet of water; the "Minotaur" class only draw 26 feet of water. Still the excess of draught of water in the "Minotaur" over the circular ship I do not deny is very great, but the immersed midship section of the "Minotaur" class has never at the load line exceeded 1,220 feet—something like that, not 1,500 feet as you suppose. Now I want to know, and I am sure you must have thought of it, and must be able to inform the meeting, and will do so hereafter, how you are going to drive a midship section that has 280 feet width through the water, when a midship section that is 60 feet wide presents such enormous difficulties that engines of 6,000 and 7,000 horse-power are required to drive it? That is one of the first difficulties that presents itself to my mind, but one which I have no doubt you are competent to remove. Another difficulty which presents itself is, with reference to the steering blades or rudders with which you intend to direct the course of your vessel, if I do not misunderstand you, if I do, you will set me right. I am perfectly well aware how you will perform your twirling operations and your little sawing with your machine when you get alongside your enemy, by means of hydraulic power, emitting water on the different sides of your engine by your hydraulic apparatus. But what I do not understand is, how upon a given course, with the sea and wind in a given direction, you will with your

steering-blades and rudder compel a circular machine like that to go on a given and straight line? My own opinion is that both wind and sea will, to use a sailor's phrase, "play the deuce" with your steering-blades and rudders, and that you will find extreme difficulty in propelling the ship on a given straight line. I daresay you have thought of that, and will be able to give us an answer upon that point also. As far as the structural details of the ship go, any person who has ever gone into engineering for a moment must be perfectly aware that they present no difficulty. There can be no doubt that you can have in that circular vessel a solid structure, that you can put upon that solid structure such armour plating as you think right, and that you can arm it with such a battery as you think desirable, and make it a perfect floating defence. Last Monday there was an able lecture delivered here on the subject of floating forts and defences. A very excellent and practical gentleman, Captain Moody, gave us his views, through the medium of Mr. Mackie, a gentleman connected with the press, a very able writer and speaker, who gave, I thought, a most interesting lecture to the meeting on the subject of floating forts, and the facilities they offer, combined with land forts, for defence. Now, if your circular fort was content to abandon locomotion, there is in it, no doubt, something that will be extremely valuable, and which ought to be considered by those whose business it is to fortify our forts and harbours. My question and the few observations I have made—I am sure you will not suppose that they are put with a hostile feeling, or in a spirit of criticism—my object only is to obtain from you that kind or information which will enable those who are sailors to form some sort of judgment of the locomotive power of that circular ship. Without locomotive power, and without steering power, the value you would put upon it, and the value this meeting would put upon it, would be very much lessened, indeed. Therefore I say, without the slightest wish to daunt the inventor—without the slightest fear of embracing any novelty, provided that novelty can recommend itself to the mind and judgment of those who have to carry into practical effect the ideas and inventions of others—without in the slightest degree wishing to put these remarks in a hostile spirit, I make these remarks with the view of telling you the difficulties that occur to my mind, that you may, before we leave this room, give us some explanation on the subject.

Commander Colomb, R.N.: I had intended to make some remarks, and I had made two or three notes, but the Controller has entirely cut away the ground from under my feet, because he has said almost everything that I should have said myself, and has expressed in far better words than I can do, the thoughts that crossed my own mind during the reading of the paper. The two points which he has adverted to are those which must have struck the mind of every person who listened,—the possibility of propelling such a vessel at a given speed, and the possibility of steering her when so propelled. In the early part of the paper, mention was made of experimental trials. I hoped at first, on hearing that mentioned, that we should have had more of the experiments and less of the suppositions. However, we had nothing, as far as I heard—I shall be corrected if I am wrong—we had nothing in the way of experiment except the towing of two structures, one against the other, at the end of a balance-rod across the stern of a boat. Of course that goes a certain way. But I must say that my own idea would have been that the only satisfactory way of ascertaining whether it was possible to propel and steer such a structure would be to have myself made an experiment on a small scale before submitting it publicly; and I question very much whether it would be possible to answer Admiral Robinson's questions, except by producing certain experiments. Of course, if those are forthcoming—and I hope we shall have them—then my doubts will be set at rest. I should say that while Admiral Robinson was speaking, a thought struck me with reference to the steering, which is in favour of that structure; that is, that wind and sea will operate equally on both sides of the line that you propose the ship to follow. In a ship which has greater length than breadth, of course the wind and sea will be acting in particular directions upon her; whereas in that ship, as far as I can see, there will be no more action on any one part than on any other. But that, perhaps, you will also advert to in your answer. If it is possible that such a ship can be driven at a speed equal to the present ships, with a lighter draught of water, and carrying a larger number of guns, as I presume she would carry, than the present ships for

their tonnage, then the advantages are such as utterly to startle us. It seems to me, if it is possible that that can be done, that we sweep away at a blow the whole of our ideas on nautical matters from beginning to end. Generally speaking, when such an idea comes across my mind, or is presented to it by the reading of any paper like this, I feel myself obliged to hold back and to keep my mind open, so as not to express a decided opinion either for or against such an extraordinary and novel proposal.

Mr. W. SMITH, C.E.: It seems to me that Admiral Robinson has forgotten that it is not a long box presenting that section throughout, but that the midship section, or section of greatest area, is only to be taken at one particular line, which of course is at the greatest diameter, but that, before and behind, taking the cross section, she should present exactly the same shape. It is a totally different thing from a box, with the same width and depth continued throughout any number of feet. If Admiral Robinson will consider it from that point of view, he will see that what appears to be an astonishing result, is almost self-explanatory, as being due to the remarkably fine buttock lines of these circular ships.

Admiral ROBINSON: I was not fortunate enough to see the experiments that Mr. Elder referred to; and of course I am a devout believer in the Baconian theory; but being a complete and thorough Baconian in my belief, I require rather a large induction before I accept it as satisfactory on any subject. One fact will hardly convey a general principle to my mind. Independently of that, I had not in the least overlooked the fact that this was a circle; and that the particular length I mentioned, 280 feet at the water line, if the diameter of the vessel was 300 feet, was something like the measure of resistance, or rather of the trench that the ship passing through the water had to dig out. But taking the lower part of that midship section, if the other be 280 feet, that lower part must be 140 feet. There is, therefore, though not immersed to a considerable depth, a greater amount to be pushed through the water than in an ordinary ship. I admit there are various refinements of the lines, as there are in an ordinary ship. I do not think that an ordinary ship is like a box. But granting that it were, granting that the ordinary ship did not divide the water forward by its fine lines, even the square box in my opinion—I will not say in my opinion—I would only ask the question whether a square box of 50 feet broad, with a perfectly square head to it, and 400 feet long, drawing 26 feet, which is the draught of the "Minotaur" class, would be more difficult to propel through the water than this, 280 feet at the water line, brought down to 140 feet at 13 feet below the surface of the water. I do not in the least wish to say anything dogmatic, or to assert that I have an opinion on the subject. I am a humble scholar seeking for truth, asking to learn and ready to be taught by anybody; and if Mr. Elder can show a large induction, a sufficient number of experiments to show a reasonable prospect of this invention being successful, there is no one will more rejoice than myself, and more ready to be on his side.

Mr. HYDE: I very much rejoice, indeed, that so able a man as Mr. Elder has presented to you a vessel or ship having a deflecting side. He has come to the conclusion, doubtless, that vertical structures are very vulnerable; and hence he has adopted a double angle all round his ship. It might be interesting to Mr. Elder if I were to show him the midship section of a vessel that is somewhat like the midship section which he has exhibited. I have no doubt he will agree with me that a ricochet shot, or a deflecting shot rather, is likely to do less injury upon a ship of his description, or of this, than any other. I simply call his attention to the fact that deflecting-sided vessels and structures have been for a very long time advocated as being the proper form on which such vessels should be constructed. I have no doubt he can tell us, and answer all questions as regards the probability of shots penetrating the sides of vessels at the angle he has adopted. Such information will be very useful.

Captain ALEXANDER, R.N.: From several remarks that Captain Colomb made, I am under the impression that he believed the plan proposed was for sea-going ships, in fact for all purposes of war; whereas I was under the impression that under present circumstances they were only proposed as sea-going movable forts; and any remarks I made for or against them, were in that view entirely, because I was not at

all prepared to consider them as sea-going men of war. I consider them capable of moving about from place to place on the coast, and even of attacking, but not as sea-going vessels.

Admiral ROBINSON: There is one gentleman in this room (Mr. Laird) whose opinion would be much more valuable than that of anybody else, who has had the greatest experience in designing and constructing ships, perhaps he will favour us with some observations.

Mr. LAIRD, M.P.: I think that the principal objection against the plan has been made by Admiral Robinson. I should like to hear that objection explained by Mr. Elder, how he intends to steer that vessel; also whether he intends it merely for coast defence, or for sea-going purposes. There is no doubt there are many advantages in the plan, and she can be made to turn rapidly. I do not quite agree with Admiral Robinson as to the difficulty of driving a vessel 280 feet wide. Therefore, after hearing Mr. Elder's explanation, if he will explain the objection Admiral Robinson has raised—the question of steering in a sea-way—I think he may get over the other difficulty. I agree with Admiral Robinson that, in the statement made with regard to the "Minotaur" class, Mr. Elder has over-stated the midship section to be driven. But by comparing the actual midship section with the midship section of his own vessel, if he can steer the vessel straight, he will enable us in the present transition state of naval matters to get a powerful vessel. As Admiral Halsted says, I am taken aback. The steering appears to me to be a great difficulty. But if Mr. Elder can only steer the vessel straight, no doubt she will be very formidable.

A VISITOR: With reference to steering the vessel, I beg to say that I have to do with sliding keels, and I have found them very efficient in making a leeway, and also keeping a direct course on the ship with a shallow draught of water. Sliding keels are very beneficial to ships of shallow draught of water. The Honourable Member for Birkenhead has had experience with sliding keels, and he can give us some information on that point.

Mr. LAIRD: It is one of the points that I should like to allude to, with regard to the form of the vessel. There were great difficulties twenty-five years ago in navigating the river Indus. Vessels of common form with straight keels could not do it: they got aground, and could not be got off. I built a vessel of very much the same longitudinal section as that vessel, with two curved ends, and no dead wood at either end. Those vessels were found to answer better than any other; they possessed great speed, and they steered uncommonly well. Mr. Elder may have some means with his water-power of getting over that difficulty; and if so, I agree with Admiral Robinson that Mr. Elder has devised a powerful vessel.

Captain ALEXANDER: While the gentleman who spoke before Mr. Laird was mentioning a sliding keel, it struck me that there might not, to our mechanical engineers and ship-builders be so much difficulty in arranging a pivoting-keel fixed in the centre of the vessel, and turning round on its centre, being movable by machinery. So that in any direction in which it might be proposed to propel the vessel, the keel might be moved to suit the purpose of the intended direction of the vessel.

Mr. ELDER: With regard to the remarks about this being a sea-going vessel, the experiments I made were with a very small ship indeed. It was an open boat built of copper. The vessel that I experimented upon along with that, was of a similar form to iron-clads, with the same proportions as to breadth, length, and depth. I towed them in all manner of seas that I could tow them in, and in the wake of steam-boat paddles. The circular ram-boat rode over the top of the wave in an elegant manner: it slid down into the hollow of the wave, and rode over the top of the next wave, and never shipped a drop of water. Whereas, the open boat in the ordinary form was very soon swamped. The two boats were made of the same weight. They were towed at the stern of a pulling boat at a velocity relative to that necessary to overcome the resistance which vessels on a larger scale would have had to encounter. The scale beam was a beam 10 feet long, with a fulcrum in the middle. The fulcrum was pivoted in the stern of the boat. I pulled my round boat, and the open boat with that scale beam, and as near as may be, the natural velocities

of the two were about a balance. I was convinced then that there was no great reason to object to the round shape on account of its resistance. Then with regard to its behaviour in the waves, I tried them in the very worst form of wave I could put them in.

Admiral ROBINSON: What was the size of the boat?

Mr. ELDER: About 5 feet in diameter.

Admiral ROBINSON: A circle of 5 feet in diameter?

Mr. ELDER: A circle of 5 feet in diameter. I was very much pleased with the behaviour of the circular boat. I must say that I am not enthusiastic, or in favour of any one thing—I try to keep clear of that—but the object to be gained by such a ship was so great, viz., that of having a vessel of immense stability, and one that could move in any direction from a state of rest without turning, for instance, that could move right up between two lines of ships, and also go across them, or go in fact in any way that the commander of the vessel might want it to go, that I thought that was a great advantage, and it might be of very great use, if it could be accomplished. With regard to the midship section which the Controller of the Navy spoke of, he must recollect that the vessel is about at least half as large again as any ship in Her Majesty's Service in dimensions. It seems that I was mistaken as to the draught of water of the "Minotaur" class. That was given to me; the draught of water as given to me was 30 feet.

Admiral ROBINSON: It would not affect your argument much. I only wished to put you right.

Mr. ELDER: I am much obliged to you, for I really am not responsible for the statement. But this vessel has 120,000 cubic feet.

Admiral ROBINSON: Of immersed area?

Mr. ELDER: No, the cubic capacity of the total ship. The total weight afloat is 16,300 tons. Now, I do not think that the largest class ship in the Service is more than 10,000 tons.

Admiral ROBINSON: The largest is 10,900 tons.

Mr. ELDER: At all events, you are comparing the "Minotaur" with a ship which is one-half larger in weight. You will find that she is not only one-half larger in weight, but that she has double the capacity, for stores and crew, and will be able to carry ten times the amount of coal. She will be able to go to America and back without coaling. With regard to the steering, if the case is a good one, we shall not stick for want of some efficient steering gear. Here is the centre of gravity of the ship, if you cause the propelling pressure to act upon this point in any direction, the vessel will certainly be impelled in the said direction whether she is revolving or not. One gentleman has asked what would be the effect if a sea did strike her. Supposing a sea did strike her, the vessel may change her course a little. But then the man in the steering turret, which is placed at the top of the sluices, will immediately open the sluice on the other side; and that self-acting turret has machinery which opens the sluices. I think Admiral Robinson was not here when I described that arrangement of sluices. (Admiral ROBINSON: No, I was not here.) The turret is driven by a donkey-engine. All the pilot has to do is to put the pointer in the position he wishes the vessel to go. That pointer opens the steam to the donkey-engine of the steering turret, and causes it to revolve till the turret points to the direction wanted, and in its course of revolving opens the sluices commanding the jet or jets behind the steering turret. The ship should then move in the required direction. If he finds she will not go exactly as expected, all he has to do is to counter her a little. The steering of the ship is not dependent upon the rudders; the rudders are merely a preliminary appendage. That is the system of steering. But if I have not accomplished it, it is for you to do it, though I feel thoroughly confident that I could do it, and I think the machinery I have prepared would accomplish it. With regard to the resistance of the vessel, I must speak from what I know, and that is described in my paper. With regard to the thickness of the armour upon the ship's deck, the ship has such an enormous displacement, that, suppose you put 6 inches of solid armour there, she would only draw 4 feet more water; 18 feet instead of 14 feet, but it is for artillerists to say whether 6 inches of armour for a flat deck is necessary. However, practice will bring that about. It is not for us to

say that we should stop there if there are other advantages that would enable us to struggle with such a difficulty. With regard to the peculiar form of the resistance, of course theorising upon it, is not so good as experiment. But you can understand that if this ship were divided into parallel strips, each of those strips would present a ship with a curved bottom to it; and each of those ships would please every man present as a good form of ship. Why then, when so many ships separately are good, are they any the worse when they are put together? I cannot understand. The resistance is of course less when the strips are put together than when separate. I believe that this system of hydraulic power is preferable to screw-propellers in such ships on account of its capability of steering the ship thoroughly, because you can steer it in all the various directions you wish to go. For instance, this ship can find her way into the most complicated channel; it will go round the most abrupt corner; and with regard to her draught of water, she would find her way into any harbour, where almost every other ship would have to stop outside. Therefore I think it possesses great advantages on account of that. With regard to its revolving tendency, there cannot be the smallest doubt that if a vessel can be revolved, and at the same time run up between two lines of ships and fire into both sides, it would be a very great property, and I think it can be obtained. With regard to exceptional fighting, I have no doubt this may be a good ship for exceptional fighting. My opinion is that it is more fitted for exceptional fighting than most gentlemen believe. I should like to see it put to the proof. Make the vessel, give it hydraulic power, and ascertain at what speed it will go. I believe you can get vessels of this class that will go 10 and 11 knots, and be able to carry an amount of fuel that will take them across to America and back again. With regard to the edges of the vessel, there is no doubt that the strength of this edge is very considerable, and there is not much of that to fire at. The vessel is very low in the gunwale, and there is only about one-eighth of an inch of edge for the shot to strike. If the shot strikes above, it will, I believe, fly over the ship; if below, it will, I believe, go right into the water. There is very small chance of the ship being damaged; and if it is struck, there is a water-tight ring all round the periphery, so that the internal portions of the ship will be perfectly water-tight. With regard to the power of sawing, it is a queer thing to think of sawing a ship when you come in contact with it. But certainly this ship will go round at the rate of about 25 miles an hour. There are about 1,500 tons of armour in its periphery, and it is all riveted together, and that amount of 1,500 tons going at the rate of 25 miles an hour, coming into collision with a ship even at a small speed will, I think, do considerable damage.

Captain W. J. Ward, R.N.: It will require a fulcrum.

Mr. Smith: That is what the Controller pointed out, that it has such a large and uniform bearing surface.

Mr. Elder: That is one great advantage in this knife-edged side; besides being able to resist shot, its shape for attacking makes it a very formidable vessel. I have made arrangements with screw propellers for the same thing. You can put a couple of screws, one on each side if necessary, and there might be a screw propeller at each end. However, that is a matter for you, gentlemen, to improve upon. All I can say is, that I think this may be made a useful ship for our country; I hope it will be so. It will be my greatest pleasure to hear that it has been successful, and that it has answered some service.

The Chairman: I must confess that I am one of the gallant Admiral's class, I am completely taken aback, so that nothing more can come from me than to request you to return your thanks to Mr. Elder for this paper. I may also mention that this is not the first time that he has favoured us with a paper in this theatre. We had from him a very valuable paper on "Marine Engines." We are therefore extremely obliged to him for coming again.

LECTURE.

Friday, June 19th, 1868.

General HIS ROYAL HIGHNESS THE PRINCE OF WALES, K.G., G.C.S.I., &c., &c., Vice-Patron, in the Chair.

COAST DEFENCES, AND THE APPLICATION OF IRON TO FORTIFICATION.

By Colonel Jervois, R.E., C.B., Deputy-Director of Works for Fortifications.

Introduction.

The principles on which fortification has been applied to the defence of this country have lately been so much discussed, and so many changes in the science of attack and of defence have occurred during the last few years, that I readily acceded to a request, with which I have been honoured by the Council of this Institution, to lecture upon the subject, popularly (or perhaps I should say *un*popularly) termed "Coast Defences," of which the application of iron to fortification now forms an important part.

It will be impossible within the limits of a lecture to give an exhaustive view of the points which it will be desirable to consider; I can only now pretend to *touch* upon the several matters which form the elements of Coast Defences, and to shew, as far as the time at our disposal will permit, the relation which the several elements bear to one another.

The Navy first, the regular Army next, the Reserve Forces, the Militia, and Volunteers, fortifications and floating batteries, combined with and supplemented by submarine mines, are each and all parts of the general system for our "Defence."

The positions and the degree in which each of these several means should be applied is a very difficult problem, and one which it is necessary to consider without prejudice for one arm of the service over another, or for one principle to the exclusion of another principle. To provide an efficient system of defence at the least cost to the State, the sailor, the soldier, the naval architect, the artilleryman, and the engineer, must each occupy his proper place.

For the general defence of the empire we must, of course, look first of all and mainly to our fleet. If our Navy could be kept up in sufficient strength to meet the Navies of other nations at all points that hostile fleets or cruizers might attack us, questions about invasion or attack upon ports and Naval Arsenals would be disposed of. Very little reflection and calculation, however, is necessary to show that the resources, even of this country, whether in money or in seamen, would not admit of our maintaining such enormous Naval means as would of themselves suffice at once to protect our commerce, to prevent an enemy landing on our shores, or attacking our widely scattered naval and commercial ports, whether at home or abroad. Other defences *besides* the Navy are essential.

Defence of Naval Arsenals and Harbours against Attack by Land.

We maintain in Great Britain a large military force of Regulars, Reserves, Militia, and Volunteers, and thereby admit the possibility of a campaign taking place in this country.

The landing of a hostile Army on our coasts must be admitted to be a difficult operation; but it would, to say the least, be very unwise if we were to conclude that invasion is impossible because it is difficult.

It must be assumed that the main object of an enemy in an invasion would be to get to London, for by doing so he would not only occupy the commercial heart of the Empire, and the seat of Government, but the main military arsenal of the empire, at Woolwich, would also fall into his hands.

Supposing him to have obtained a footing on shore, and to be advancing on London, we interpose between him and his object the Regular Army, in conjunction with the armed and organized manhood of the country more or less disciplined, and aided by such temporary defences as could be thrown up in support of the field of battle at the time of expected attack.

But as the best disciplined and the greater part of our military forces must be employed to cover the capital, we must arrange our plan of defence so that as few disciplined troops as possible may be necessary for the defence of other points in the country which must be defended, but which cannot be covered by the operations of the main Army.

Portsmouth and Plymouth, for instance, are therefore defended on the land side by the aid of fortifications which will enable a comparatively small number of partially disciplined forces, with the aid of a few regular troops, to protect those places against capture or bombardment, whilst the main Army would be employed in the defence of London and Woolwich.

A mistake is commonly made that because the stations I refer to are fortified, the garrisons of those places must be largely increased. The case is precisely the reverse.

Supposing all the outer line of forts to landward at either Portsmouth or Plymouth to be fully manned at the same time (which would be quite unnecessary—not more than one-half need be fully manned at the

same time), only between 6,000 and 7,000 men would be required for the purpose at each place respectively, and only a very small portion of these need be regular troops. The remainder of the garrisons would consist of a moveable force, which in any case we *must* have for the defence of these places, but which in the absence of the forts must be of sufficient strength and sufficiently disciplined to meet the enemy in the open field, whilst *with* the forts it may be comparatively small in number, and only disciplined to take up a fighting position, under the support of the works, at that part of the fortified line assailed.

*Un*fortified, an enemy would only have to detach about 15,000 or 20,000 men from his main invading army to effect in a few days the destruction of all our ships and naval establishments at Portsmouth; fortified, he must employ an Army of at least three times that number, and must have a considerable time at his disposal to undertake a regular siege.

*Un*fortified, no force that, in the case referred to, we could afford for the garrisons of these places could protect *either* against the attack of 15,000 regular troops. Fortified, there is no difficulty in providing the numbers and description of troops that would be capable of making a good defence of these nurseries of the Navy.

*Un*fortified, they at once fall if an enemy were to obtain a decisive victory over the Army in the field; fortified, they remain in our hands even under such untoward circumstances, and thus enable us to avert the destruction of our naval power at a period when all the resources of the country would be required to enable us to retrieve the position we had temporarily lost.

The foregoing observations refer to the extended lines of works which cover our naval arsenals against attack by land. We have other defences against attack by an enemy on shore (for instance, the fort at Newhaven), which have for their object to prevent an enemy, who may have been enabled to land a comparatively small force, obtaining possession of harbours which, exceedingly valuable to us, as sheltering our cruizers and squadrons against attack by a superior force at the particular point assailed, would be admirable bases of operation for an enemy to harbour his men-of-war and transports for landing an Army, especially the artillery, cavalry, and stores.

With the harbours on our coast thus defended, invasion becomes much more difficult, owing to the enemy being thrown upon the open beach to effect a landing. The works for the defence of these places absorb only a small and a partially disciplined force.

I have made these observations in the first instance respecting fortifications which provide against attack by an enemy on shore, in order to avoid any chance of their being mixed up with defences which are required for the purpose of resisting naval attack.

The former are not liable to be attacked by iron-clads and big guns, and their armaments may be of a comparatively light description.

As regards attack by land, we have to provide against the great range, accuracy, and penetration of rifled ordnance; but the ordnance used by a besieger must still be comparatively light. Such pieces as

Fig. 1.

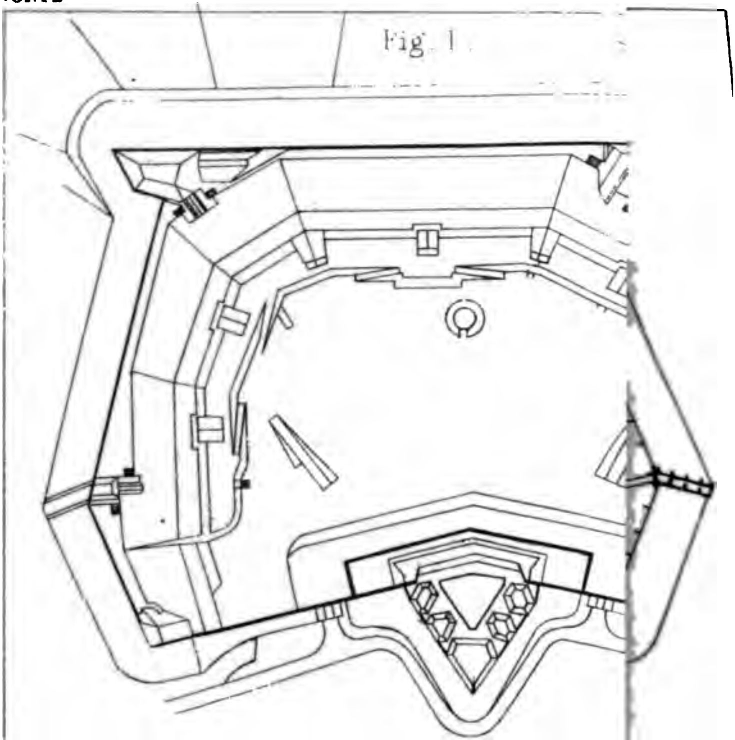


Fig. 3.

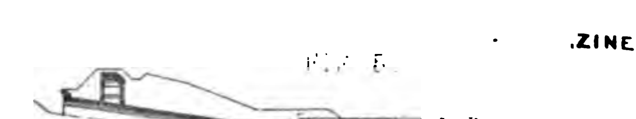


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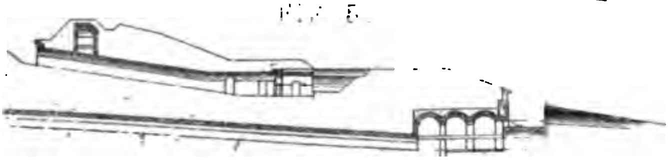
Fig. 5.



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our 12-inch or 600-pounders, weighing 23 tons,—as the 10-inch or 400-pounders, weighing 18 tons,—as the 12-inch or 250-pounders, weighing 12 tons,—or as the 7-inch or 115-pounders, weighing 7 tons, —together with the ponderous ammunition for them, cannot be dragged about on land.

It was the armour-plating of *ships* that caused the introduction of these great guns, and it is *in* ships and *against* ships—not *in* forts or *against* forts intended only to resist land attack, that they are required to be used.

Description of one of the new Forts intended to resist Land Attack.

This appears the proper place to describe one of the forts lately constructed to resist attack by land. I will take, as an example, Fort Purbrook, a work on the right of the chain of forts occupying the Portsdown position. (Diagrams of this work are shewn in Plate xxxi).

The rampart is a massive earthwork, with a deep and narrow ditch in its front (Figs. 1, 3, and 6). The trace of the rampart does not follow the line of ditch, but is arranged so as to afford a fire of artillery and musketry nearly equally upon the front and flanks, whilst the ditch is arranged so as to complete the enclosure with as few sides as possible, in order to simplify the arrangements for flanking it.

The rampart is so retired from the escarp (see Fig. 3), that the continuation of its exterior slope strikes about two-thirds down the escarp wall; thus, even if the escarp were breached, the rampart would not be brought down. At the top of the escarp is a *chemin-des-rondes* wall, which, besides raising the height of the escarp, would prevent any portion of the rampart that might be brought down by the fire of shells from falling into the ditch, and would enable the rampart to be reformed.

At intervals on the rampart (Fig. 1), bomb-proof shelter is provided under traverses, beneath which again are small magazines for the immediate service of the guns. Shell stores and shell-filling rooms behind the rampart may be added at a time of expected attack, or, if necessary and funds were available, may be constructed permanently. It is to be observed that in works to resist land attack, there is not the same necessity as in sea defences for these last named preparations being permanently made.

The parapet (Fig. 1) is at present left without any of the usual arrangements of embrazures, platforms, and racers for guns, so that if the Moncrieff carriage (to which I will hereafter refer more particularly) is adopted into the service, this system for mounting artillery may be applied. The Moncrieff carriage will not, however, admit of protection against vertical fire; it, therefore, appears desirable that at the shoulders and salient of the work, casemated batteries for three or four guns each, and covered with iron to the front, should be provided at a time of expected attack. We should thus have artillery fire over the whole space in front of and on the flanks of the work protected, on the barbette principle of Moncrieff, against direct fire, and protected

both against direct and vertical fire by the iron-fronted casemated batteries. This I believe now to be the principle which should be adopted in the arming of fortresses intended to resist land attack.

It has often been suggested that iron turrets should be applied at the salients of land works; but I do not think that any advantage would result from such application, sufficient to compensate for their great cost. We do not require to follow up the siege battery or attacking force on land, as we do the moving vessel at sea; and so one of the great advantages of the turret does not apply to works intended only to resist land attack.

The ditch of the work (Figs. 1, 2, 3, 5) is flanked by caponiers for guns and musketry, which, being well sunk, and perfectly secure against being struck by an enemy's direct fire, are of slight construction, except as regards the roofs, which are bomb-proof.

It is sometimes urged that iron should be applied to protect the caponiers, and the flank defences of ditches from the breaching effects of rifle guns from long ranges. This is, however, unnecessary, if, as in the case of our new works, the flank defences are covered by high counterscarps, and are so arranged, that their prolongations cannot be taken up.

To the rear (Figs. 1, 2, 3), where the work is not subject to the artillery fire of an enemy, the escarp is exposed, and at the centre of the gorge (Fig. 2) is a casemated barrack with a projection in its centre called a redan, which flanks the rear of the work, and also brings an artillery fire to bear over the rear of the position.

Underground galleries of communication (Fig. 2) connect the casemated barrack with the caponiers flanking the ditch, and a staircase in a central position (Figs. 2, 3) leads from the galleries to the terreplein of the work.

The main magazine (Figs. 2, 4) is placed underground, off one of the galleries, and near the bottom of the central staircase.

Fig. 6 is an exterior elevation of the work, and shows the appearance it would present to an enemy attacking it.

Defences against Naval Attack.

I will now proceed to consider defences against naval attack.

To provide against naval attack on a port during the absence of the fleet, big guns, with all the numerous accessories for their service, are necessary; and these must be placed in positions so protected and arranged as to give them a decided superiority over the artillery of assailing ships.

The question then arises whether they shall be placed afloat in strongly protected vessels, *i.e.*, in floating batteries; or at fixed points either on land or on shoals, *i.e.*, in forts.

The proposal to defend our ports against naval attack by floating batteries alone, implies however, that we must maintain at each of our chief ports a naval squadron sufficiently powerful to resist, during the absence of our sea-going fleet, the attack of a superior force of the enemy. Then arise the questions, what *is* a sufficiently powerful force

to maintain at each point for this object? what would be its first cost? in how many years will it be necessary to repeat the outlay for it? what will be the expense of its annual maintenance?

It is impossible to examine these questions without arriving at the conclusion that even if our resources in money and in seamen rendered it practicable to maintain such a force in addition to our sea-going Navy, the defence of our ports can be effected much more efficiently and economically with the aid of other means. As on land, fortification enables us to economize in troops; so, on the sea-coast, we can, by the same means, economize in ships by providing for the protection of our harbours against naval attack.

Irrespective, however, of the question of the expense of providing for coast defence by floating batteries alone, very little consideration is requisite to understand, that if there be positions on land from whence an effective fire can be brought to bear on the channel, anchorage, or shore to be defended, there is no object in placing the guns in vessels afloat.

In positions such as I have referred to, there cannot be any object in substituting an unsteady platform on which the amount of protection that can be afforded is limited by considerations inherent to floating structures, and which is liable to be taken away or to be sunk, for a fixed and perfectly steady platform on shore, which can be fully protected, either against its fire being silenced, or from capture by an enemy.

In cases, however, where the distance between forts is so great that the intervening space cannot be properly commanded by their fire, or where it may be necessary to have advanced batteries of artillery at a distance from the shore, and where foundations for fixed works cannot be obtained without expense and difficulty disproportioned to the object, it becomes *necessary* to employ floating defences.

In short, we must, in each case, consider—

1stly. Whether we can provide for the defence by forts *without* floating batteries.

2ndly. If not, to what extent floating defences should be applied in *conjunction* with forts. And

3rdly. Whether the circumstances are such as to render it advisable to employ floating batteries in *substitution* of forts.

The question is not one as it is often put, of "floating batteries *versus* forts." There is no "versus" in the matter. Both are required in their proper places.

Whether, however, the batteries for the defence of our harbours be fixed or floating, submarine mines, of which I will presently speak more particularly, should be employed in conjunction with them.

Description of Vessels adapted for Harbour and Coast Defence.

The question of the *kind* of floating battery to be employed for harbour defence has from time to time been much discussed.

Ten years ago, at my suggestion, a Committee was appointed by General Peel to consider the subject. Admiral Cooper Key, Colonel

Wilmot, R.A., and myself were the members of this committee. We then recommended the employment for harbour defence, of small vessels, each carrying a fixed iron tower for four guns, and provided with eight ports. It is curious how nearly this vessel approached the "Monitor" type first used in the memorable fight at the mouth of the James River, in America in 1862. I believe it is generally admitted that the "Monitor" class of vessel is the best kind of armour-clad floating battery for coast defence, but amidst the many projects for defensive floating structures now advocated, I do not offer a decided opinion on this subject. In some cases iron-clad "Monitors," supplemented by a mosquito squadron of gun-boats, might be employed, and to oppose unarmoured cruizers or privateers (to the attacks of which alone the less important harbours would be liable), small gun-boats of light draught, in conjunction with submarine mines, would alone suffice. I have here a model of a small gun-boat for one gun, proposed by Mr. Rendle, of the Elswick Ordnance Company, which appears admirably well adapted for the small class of vessels for harbour defence.

Obstructions.

Another and a scarcely less important element of coast defence than either forts or floating batteries, is that of obstructions, which are now in most cases essential to keep an enemy's ships under the fire of the guns of forts.

Obstructions are of two kinds, passive and active.

Passive Obstructions.

Passive obstructions may consist of rafts or barges, booms of timber, chains, nets, wire, or rope, sometimes (in places which it is unnecessary to keep open) of piles, stones, dams, or sunken vessels. The attention that has been given during the last few years to the application of submarine-mines has, however, rendered it improbable that we shall find it necessary to use *passive* obstructions.

Active Obstructions.

Active obstructions, or submarine-mines have become of especial importance since iron-armour has been applied to the sides of ships of war, these vessels being most vulnerable in their bottom. Submarine-mines should, as I have just stated, be placed between the forts or batteries on either side of the channel which they are intended to defend. They may also be employed in connection with either fixed or floating batteries, to prevent an enemy occupying any particular position within range of the guns from which it is desired to exclude him. Attempts had been made by the English so early as the 17th century, to apply floating and submerged charges of gunpowder for purposes of offence and defence. The Russians in 1855, however, were the first to apply explosive machines of this kind with any approach to success; and, although the mechanical self-

acting torpedoes which they laid down in the Baltic were somewhat defective of construction, there is little doubt that they might have produced disastrous effects upon our ships, had the charges of gunpowder employed in them been sufficiently large. The Russians were also the first to attempt the employment of electricity for the explosion of torpedoes, though their arrangements for this purpose never appear to have been placed in position for actual use.

The successful results attending the employment of torpedoes as engines, both of attack and defence, by the Americans, and more especially by the Confederates in the recent war, have attracted considerable attention to these engines of destruction. Though the means at command were limited, and the arrangements generally of very crude description, there are official records of the destruction of no less than 24 ships of the Federal States, and of the injury of 9 others by means of torpedoes. The progress made in the application of these mines during the Civil War in America, is shown by the fact that whilst in the year 1862 only one Federal vessel was destroyed, in the first four months of the year 1865, eleven were destroyed or sunk, and four injured.

If it is considered that the area of water or passage to be defended may be perfectly closed against *friendly* vessels without disadvantage, the employment of torpedoes which are exploded by self-acting *mechanical* contrivances present advantages over torpedoes which are exploded by electricity, as being less costly, and more expeditiously placed in position.

This class of explosive machine would be of a size to contain about 150 lbs. of powder; and would be so moored as to be within range of the bottoms of vessels of small size. They can be fitted up and placed in position with great expedition, and, their cost being comparatively small, their number could be so large that even the most careful search after them by the enemy would fail to render a water safe to their ships.

These mechanical torpedoes are, however, altogether inapplicable in positions where it is desired to keep the water open to friendly vessels, and to close it effectually against an enemy.

In such instances it is indispensable that submarine mines should be arranged to be exploded by electric currents.

Electric torpedoes or mines may either be self-acting, *i.e.*, their explosion may be accomplished by the collision of a ship with them, or with a mechanical arrangement floating near the surface and connected by an electric cable with the mine beneath; they may also be exploded at will by operators on shore, when a ship is observed to be over them or in their immediate vicinity; or they may be so arranged, that the collision of a ship with the self-acting mechanism with which they are provided, will instantly give a signal at the station on shore, whereupon the mine may be at once exploded by the operator at the station. Lastly, the torpedoes may, by simple means, be so arranged, that they may be either exploded spontaneously by a passing ship, or at the will of the operator on shore, in the possible event of the ship not coming into contact with the self-acting trap.

The torpedoes would be placed several fathoms below the surface, and at such distances apart that the explosion of one would not injuriously affect those in its vicinity. Their charges would be sufficiently large to ensure the destruction of a ship by their explosion, not merely when immediately over one of them, but even if any portion of her were within 40 or 50 feet of that position. It is obvious that by arranging the torpedoes in two or more chequered lines, a vessel, even if passing harmlessly between two torpedoes in one line, must come within destructive range of a torpedo in the second or the third line. The placing of torpedoes at considerable depths, and their arrangement for optional explosion from on shore, must render it extremely difficult for an enemy to interfere with such a defensive arrangement, and such interference is impossible if the area of water defended, is guarded by artillery. It is often stated that the torpedoes may be removed at night, but this objection is effectually met by lighting up the channel by the electric or other lights which may be employed for that purpose.

The knowledge and experience acquired within the last few years regarding the application and effects of explosive agents more destructive in their action than gunpowder, have demonstrated that some of them, and especially gun-cotton, may be advantageously employed in submarine mines. The Austrians used gun-cotton as the explosive agent in torpedoes, which were applied by them to the defence of Venice, and the results which they obtained in experiments with these, indicated that a submerged charge of 400 lbs. of gun-cotton produced destructive effects at least equal to those obtained with 1,000 lbs. of powder. Improvements recently made by Mr. Abel, the eminent chemist of the War Department, in the preparation of gun-cotton, have led to a very considerable reduction in the space occupied by a charge of that material, and experiments with the new form of gun-cotton, have demonstrated that very important advantages, both as regards destructive effect and reduction in weight and dimensions of a charge, are secured by the substitution of gun-cotton for gunpowder, as the explosive agent in torpedoes.

The submarine mines I have referred to, are all stationary, and strictly defensive in character. Torpedoes may, however, also be used offensively by means of small vessels specially constructed for the purpose, to which these mines may be fixed at the end of a long pole, and an enemy's ship thus sunk by ramming.

In order to ensure the ready application of these means at a time of impending attack, the necessary arrangements for their construction should in each case be well considered and matured beforehand, and, as is now being done, Officers and men of the Royal Engineers, as well as in the Navy, should be specially trained to ensure their proper application.

Six years ago, being much impressed with the necessity for having well matured plans for employing obstructions and torpedoes in the defence of our ports, I submitted to Lord de Grey, then Secretary of State for War, that a Special Committee should be appointed to consider and report upon these questions.

Lord de Grey at once recognized the importance of such an enquiry, and appointed a Committee which has up to the present time been engaged in this duty, and I beg to say that its labours have been conducted none the less efficiently because they have been prosecuted quietly.

The Committee, after making many experiments, have already reported on one branch of the subject, viz., that of passive obstructions, and their report on active obstructions, or submarine mines, is just completed. By the labours of this Committee, consisting of Col. Askwith, R.A., Captain Horton, R.N., Lt.-Col. Fisher, R.E., Captain Brandreth, R.N., Jas. Fergusson, Esq., and last, not least, Mr. Abel; by the experiments also which have been carried on by the Royal Engineers at Chatham, under the able direction of Colonel (now Major-General) Simmons, and by the Royal Navy at Portsmouth and Plymouth, the public service has greatly benefited as regards the development of this formidable adjunct to our national defences.

Torpedoes must not be regarded as substitutes for Forts and Batteries.

The question then arises, how far, if at all, does the use of submarine mines affect the employment of forts and batteries for defence against naval attack?

I answer that forts and batteries are still required in all important cases to cover the torpedoes, and prevent their being tampered with. It must also be remembered that whilst the submarine mine is harmless unless the ship comes near it, the shot from the battery can injure the ship whatever may be her position within effective range.

Further, although probably our harbours might be efficiently obstructed by torpedoes in at from 7 to 14 days' notice, yet one condition is that the weather should be sufficiently favourable to allow of their being exactly laid. There are again certain positions where even if the torpedoes *are* laid they might be disturbed by a violent storm, and possibly an attack on the positions in which they were to serve, *might* take place before they could be renewed, and though the periods of the year at which these difficulties might arise are short, yet the bare possibility of interference in the application of a complete torpedo system, prevents our placing entire reliance on such a defence for the protection of places on which the warlike power of the nation, both for offence and defence, must in a great measure depend. Therefore, although submarine mines are a most important element in the defence of our harbours and coasts, and add greatly to the power of our forts to resist a naval attack, yet they must not be regarded as substitutes for permanent works of defence at our Naval Arsenals and Harbours, and other important ports.

Submarine mines would not only be of immense advantage for the defence of our harbours in time of war, they would also, in conjunction with small gun-boats, be most valuable for the protection of places on the coast, like St. Leonards or Brighton, against privateers who might, perhaps, in the absence of other defence (which in these cases cannot

be applied on shore) levy contributions upon the inhabitants of these and other watering places.

Construction of Forts and Batteries to resist Naval Attack.

We now come to consider the construction of forts and batteries to resist naval attacks.

Before considering batteries for *guns*, I must first refer to the advantage, in some cases, of vertical fire, where it is desired to prevent an enemy occupying a certain anchorage. The deck of the ship, like the bottom, is completely vulnerable, and judiciously placed batteries if armed with a sufficient number of mortars, throwing "bouquets" of shells into the air, would be so excessively disagreeable that an enemy would no doubt hesitate to take up a position where he was liable to such treatment.

The Royal Artillery, have under consideration a rifled howitzer, which will afford vertical fire with accuracy, whereas mortar fire is somewhat wild and dependent on quantity for its effectiveness.

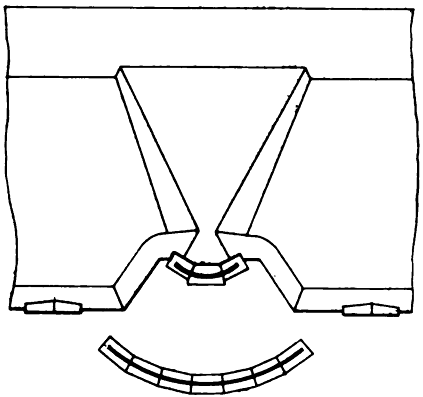
The simplest form of battery for guns is one to fire *en barbette.* (Figs. 1, 2, plate xxxiii.) In this case there is no difficulty about the construction of embrasures, the requisite protection for the guns and gunners against horizontal fire being obtained by an unbroken parapet. The exposure to which the Artillery would be subjected in batteries on a comparatively low level, if the guns were always seen above the parapet, renders it undesirable, however, to construct batteries *en barbette*, except at a considerable elevation, say about 100 feet above the sea, in which case the guns and men working them are scarcely seen from seaward.

It is, however, undesirable in any case to construct batteries *en barbette* where they would stand out in strong relief against the sky line.

The advantage of a barbette battery is the great extent of lateral range of the guns which can be obtained, and it is a question on which differences of opinion have always arisen, according to the taste of the individual, whether it is better to obtain this at the probable expense of gunners' lives, or to have a limited amount of lateral range, coupled with greater security. I believe that about the limit of the application of ordinary barbette batteries, is the elevation above the sea, to which I have just referred.

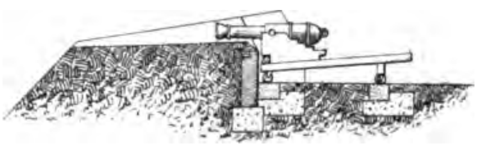
For the better protection of artillery in batteries at low elevations, the guns themselves, instead of being arranged so as always to show above the rampart, are placed *behind* the parapet, in which cuts or embrasures are made to fire through (Figs. 1, 2, plate xxxii), as at Lumps Battery, Southsea. Here the throats of the embrasures are nearly in the middle of the parapet, so that the merlons between the guns act the part of short traverses, separating gun from gun, though not separating the rear parts of the platforms. The plan of forming the parapet in this manner, moreover, admits of the guns being covered over by "blindages" of timber and earth, for protection against shells exploding over the guns and gun detachment. The necessity for further

Fig. 1.



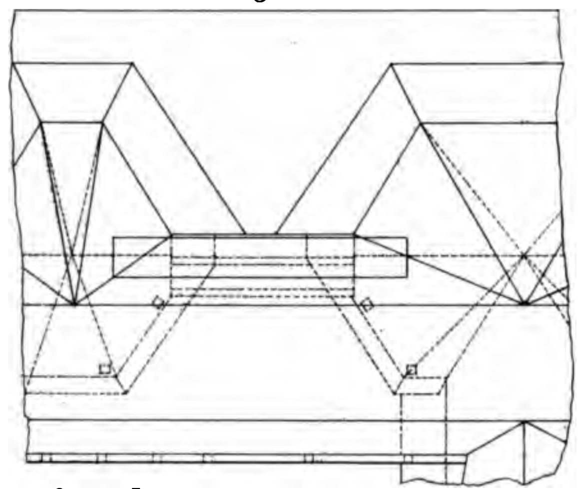
EARTHEN EMBRAZURE (OLD TYPE)

Fig. 2.



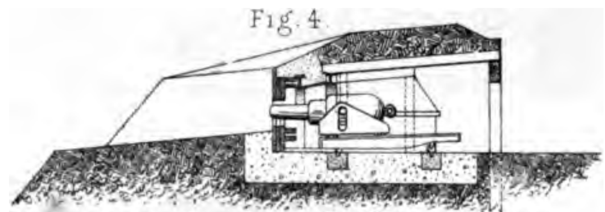
SECTION OF FIG I.

Fig. 3.



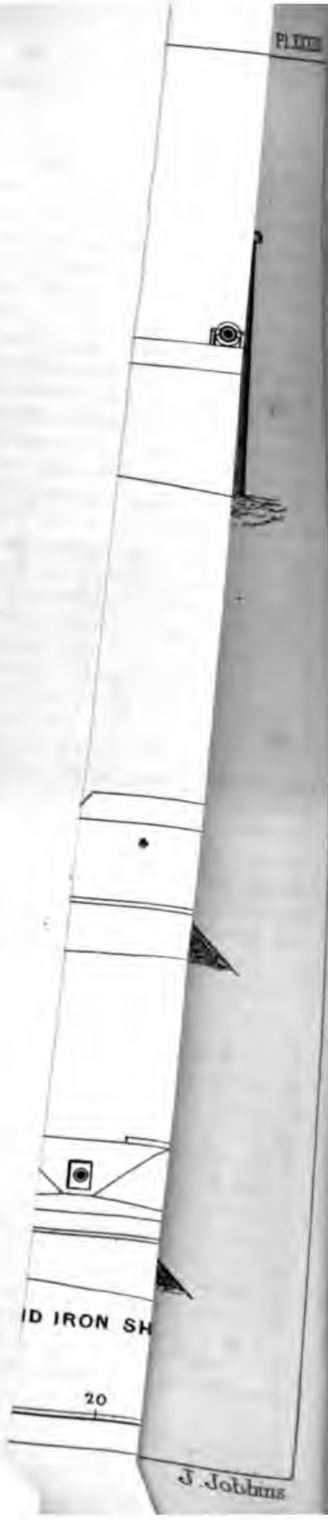
SHIELD EMBRAZURE, WITH SPLINTER PROOF COVERING TO GUN.

Fig. 4.



SECTION OF FIG. 3.

SCALE 20 FEET = 1 INCH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strengthening the embrasures has led to placing an iron shield in the opening of the embrasure. (Figs. 3, 4, plate xxxii., and Figs. 6, 7, plate xxxiii.) The cover between the shields, however, if composed of earth alone, must necessarily be comparatively weak, more especially at the junction with the shield, and in order to afford the requisite resistance, should be also strengthened by introducing masonry, brick-work, concrete, or other suitable material.

Indeed, in all cases in which the space will not admit of the requisite degree of strength being obtained by the additional thickness of earth necessary to resist modern projectiles, the plan of inserting Portland cement concrete, a wall, or perhaps a thin iron plate, in the interior of the parapet should be adopted.

Even where there is no limit with respect to space, if earth is not procurable at reasonable cost, or if the breadth of the work cannot conveniently be made sufficient for an earthen parapet, as for instance on a narrow headland, or on a foundation constructed in the water, it may be necessary to employ other material.

In these cases, masonry or brickwork alone was formerly applied to the construction of batteries.

Masonry *alone* is, however, no longer admissible at the embrasures of works; as in the case of earthern batteries, iron must be substituted at those parts of the work which must necessarily be thin, in order to allow of sufficient lateral range and space for the efficient working of the guns.

The subject of structures with the exterior wholly of iron will be referred to subsequently in dealing with the question of casemated batteries.

Specimens of open batteries, with the guns *en barbette* may be seen at the Needles' Point, Hatherwood, and Warden Point. These are all high above the sea, and the guns sweep the whole channel o the Needles, from the Point upwards. (Figs. 1, 2, plate xxxiii.)

A specimen of open batteries prepared for iron shields may be seen on either side of Southsea Castle.

Turrets.

The lateral range obtainable in the barbette system, combined with the protection afforded by the embrasure and iron shield plan, can be obtained by the employment of turrets, which may be employed without reference to the elevation of the battery above the water. The origin of the invention of the turret by Captain Cowper Coles, to whom we are so much indebted for the proposal, was the protection of deck or pivot guns on board ship, by means of shields. To effect this, and at the same time to obtain the greatest lateral sweep of the gun, it was necessary to place both the guns and the men working them, on a turntable, and to attach the shield to the turntable, so that the gun, the gunners, and the protection should revolve together.

The objection to turrets is, that they are very expensive. The cost of a turret for two great guns,—the most economical arrangement of the system,—is however, not less than £15,000, and this irrespective

of the basement of masonry and iron on which it must be mounted, and which must contain magazine accommodation for powder and shells, and space for men. This basement will not cost less than from £5,000 to £10,000, according to whether the turret be alone, or forms part of a work, so that the total cost of a turret complete for two guns, is not less than from £20,000 to £25,000. The question then arises whether that amount of money can be applied to any other kind of work, so as to afford a more powerful fire upon the space to be commanded than can be obtained from two guns in a turret. In many cases it will be found that it *is* so; in other cases, however, like the Spithead forts, where the works are entirely surrounded by water, it will be found that in order to employ the most powerful guns with the greatest effect, it is necessary to employ turrets. (Figs. 1, 2, plate xxxvi.)

Segmental Shield.

Another plan for mounting guns on turntables, and at the same time protecting them by iron shields, is to give the shield the form of a segment of a circle, in which are two or more ports, according to the extent of lateral range required. A turntable affords the means of turning with facility from port to port, and when fixed with the gun opposite one of the ports, the arrangement for traversing is the same as in an ordinary battery with iron shields. By means of the turntable, the gun may also be rapidly turned round with its muzzle to the rear, and this affords great facility for loading.*

In cases where great guns are mounted *en barbette*, it will be found advantageous to place them on small turntables, without any shield.

Moncrieff's Carriage.

I must now notice a very important invention with regard to gun-carriages, which, probably, will very greatly affect the construction of the parapets of open batteries, and which, though not a *substitute* for turrets in all cases, will afford the advantage of lateral range obtainable from turrets and guns on turntables, or *en barbette*, without exposure of the gun to direct fire, except at the time when it is being laid and discharged.

The principle I refer to is that which has lately been so successfully dealt with by Captain Moncrieff, of the Edinburgh Militia Artillery.

Very ingenious suggestions, with a view of attaining the same object, have also lately been made by two Officers of Engineers, Lieutenant Hogg and Lieutenant Lloyd. These two last named Officers proposed to effect the object by different plans, but both by means of two guns, one counterbalancing the other, and to fire alternately.

Captain Moncrieff, in *his* plan, mounts the gun on a carriage with curved sides, which rock on a level platform; attached to the carriage is a counterpoise weight, rather in excess of the weight of the gun, and which raises the gun,—thus enabling it to get up, like a man, to fire

* Diagram not engraved.—W.D.J.

over the parapet, whilst it stores up the recoil; when fired, the gun makes as it were, a low curtsey, and retires behind the parapet. (Figs. 4, 5, plate xxxiii.)

There would not be time for me now to enter into the details of the construction of this carriage; and it is unnecessary for me to do so, as Captain Moncrieff has himself fully explained them in two papers which were read by him on the subject in this place.* The nature of the action will be understood from the model you see here.

The great point of this invention is, that it enables us to protect guns in open batteries by a parapet unweakened by openings, and thus to have the advantage of the great lateral range of barbette batteries, even at a low level above the water, without exposure, except at the moment of firing; it enables us, at the same time, to avoid using iron shields at the embrazures of open batteries, and thus to effect a saving of expense.

Some extra expense may probably be necessary for this gun-carriage as compared with one of the late service-pattern carriages, but I doubt the Moncrieff carriage being dearer than a muzzle-pivoting carriage (which is necessary to afford the smallest opening for an embrazure), and it is with this that its cost should be compared.

But however this may be, the extra cost of the Moncrieff carriages, when applied in any number, cannot, I conceive, be equal to the cost of an iron shield, and it is from this point of view that the question should be regarded. Fortunately we advisedly deferred the provision of iron shields for our works in this country; we are, therefore, in a position, supposing the Moncrieff carriage to be adopted by the artillery authorities, after the full trials which it must necessarily undergo at Shoeburyness, to apply it in all the open batteries in which it has hitherto been proposed to provide iron shields, and that without any expense in the works, except the alteration to the parapets and to the traversing arrangement for the guns.

After witnessing the late experiments with this carriage, I did not hesitate at once to submit proposals for the application of the invention to several of our new works of fortification. Works constructed for carriages of this description will not afford protection against vertical fire, nor are they applicable in cases in which casemated structures are necessary.

Casemated Sea Batteries.

A work for sea-defence must be casemated when it is necessary to provide by tiers of guns, an amount of fire which cannot be obtained by a lateral extension of the work. A sea-battery should be casemated, when otherwise it would be liable to be plunged into by fire from ships. Casemates are also applied in some cases when it is necessary to secure the battery against the fire of infantry from the rear, and when this cannot be effected by traverses, or when the work is on the side of a hill, or being in front of another battery, must be secured from splinters of rock or shells.

* Vide Journal of the R. U. S. Institution, vol. x, page 480, and vol. xi, page 241. Ed.

It will be found in many cases that for sea-batteries, a casemated construction is on the whole not only more efficient, but more economical than a fort with an earthen parapet, supposing the same number of guns to be provided for in each case. The reasons for this are, that whilst in an open earthen battery, the barracks, magazines, and other accessories have to be provided for separately, and the defensive enclosure must be of large area,—and in addition to the battery; —in a casemated work, the battery, barracks, magazines, &c., are provided under the same roof, and the defensive enclosure, which is comparatively small in extent, is formed by the casemated structure itself.

Before describing any particular type of modern construction, different forms of casemate-embrazure and exterior walls that were adopted in sea-defences, prior to the introduction of iron in the casemated batteries may be noticed. Figs. 1, 3, 5, plate xxxiv., show one type adopted in works in England. Fig. 4 is a type of embrazure at Cherbourg.

Introduction of Iron.

The increase in the power of artillery, however, required a stronger construction than these, and the necessity for employing iron was recognised and put in practice.

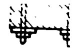
First Introduction of Iron.

The Americans, in their recent casemated forts (which are of two, three, and four tiers in height, with the front walls of granite), introduced pieces of iron 8 inches thick on either side of the throats of the embrazures (Fig. 6, plate xxxiv). These, however, being small and altogether dependent on the masonry, which at this part of the work is only 5 feet thick, cannot be expected to add much to the amount of protection afforded by the casemate to the gun and its detachment, when subjected to the fire of powerful rifled guns.

The Russians have lately strengthened with iron a few of the embrazures of their casemated forts at Cronstadt (Fig. 2, plate xxxiv).

The designs prepared in 1861 for the casemates in the English sea-defences (Fig. 3, plate xxxiii, and Figs. 7, 8, 9, 10, plate xxxiv), provided for greatly increasing the dimensions and strength of the mass of the masonry of the work, and for entirely omitting the masonry round the embrazures, where, owing to the necessity for having sufficient space for the working of the guns, it was weak. Openings were thus left for iron shields, and the construction was arranged so that the iron might be inserted in the openings at any time, when artillery questions relating to the amount of strength necessary to be given to the shields could be positively defined, and when the dimensions and precise position of the embrazures in the shields could be decided in accordance with the newest kind of gun-carriage.

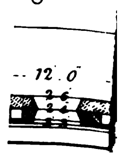
Besides increasing the thickness of the exposed masonry, and substituting iron for granite in the space immediately about the guns, the arches of the casemates have been constructed so as to make the



7

ELEVAT

Fig 7.



whole roof afford support to that part of the masonry above the shields and piers. (See Fig. 9, plate xxxiv.)

Figs. 6, 7, plate xxxiv, shew the mode of construction thus described, compared with the recent American casemated sea-defences.

Figs. 8, 9, 10, plate xxxiv, shew a work of this description for one tier of casemates. This model shows a work of granite with iron shields for two tiers of casemates, similar to that in Fig. 3, plate xxxiii.

These types of work are the most approved for granite casemated batteries combined with iron at the embrazures, and represent the degree in which, with an interval of 24 feet between the guns, the two materials (granite and iron) may be employed.

The introduction of more iron necessitates a reduction in the amount of granite, and the masonry thus becomes so weak that, if the interval between the guns is to be kept at a minimum, it may be better to incur the expense of making the whole exterior wall of iron, and to adopt a different system of construction.

Further application of Iron.

I will now refer briefly to several proposals which have been made from time to time for the application of iron to fortification. There will not be time to enter technically into this matter; I may, however, be able to convey a general idea of the present position of the question.

The subject divides itself under two heads:—

1. The construction of shields for insertion at the embrazures of casemated forts in which the Moncrieff carriage cannot be used.

2. The construction of the outer walls of forts, whether when made wholly of iron, or of masonry, or other material, and iron, combined.

First as regards shields for embrazures. One of the first ideas of the application of iron to forts is shewn in this diagram. It consists in plating the sides of a masonry embrazure constructed on the old principle. Independently of its not affording much power of resistance, this form is open to the objection that, being funnel shaped, it is calculated to deflect shot, and especially grape and cannister, into the embrazure.

Attention was then directed to obtaining a rectangular iron shield, with a port in it, to occupy the otherwise weak part of the embrazure.

Obviously, if solid plates of the full size of the shield could be made, and could be obtained at reasonable cost, all difficulty of joints, bolts, &c., would be avoided, but the normal dimensions for shields generally, viz., 12 feet wide, by 8 feet high, are greater than those in which any plate of even moderate thickness has yet been manufactured.

Messrs. Brown of Sheffield, acting on a suggestion of Lieut. English, R.E., are about trying to obtain solid plates of these dimensions, but as yet we do not know whether this can be done,* or, if successful, what the cost will be.

As shields of the dimensions referred to, could not be obtained in one

* This has since been done, but the cost is not yet known.—W.D.J.

piece, various proposals have been made for constructing them with several pieces of iron, by using bars, plates, planks, rails, &c.

When the application of iron to forts and batteries was taken up some years ago, the object sought was an inexpensive mode of applying it, so as to avoid what was then considered to be the great cost of armour plates.

The first proposal was to use bars, tongued and grooved, and held together by bolts passing through them, or by vertical pieces behind, attached to dovetails on some of the bars.

It was found, however, that the numerous joints and the difficulty of keeping the bars together were against their adoption, unless they were applied in a manner which failed to effect the object for which shields composed of bars were first proposed, viz., economy.

The Russians, however, persevered in the bar system (Figs. 4, 5, plate xxxv), and in one of their most recent constructions I understand they propose horizontal bars 12″ thick and 12″ deep, backed by vertical bars of like dimensions, and covered on the outside surface with two layers of thin plates.

The result is a shield costing about £3,000 per gun.

The first shield they had made on the bar principle was 12 inches thick, and cost about £2,200 per gun. It is shewn in the diagrams. (Figs. 4, 5, plate xxxv).

It is not so strong as shields of the same thickness which cost this country less than £1,000 a-piece, and are known as the "Gibraltar" shield (Figs. 1, 2, 3, pl. xxxv).

This shield was made on an emergency, and did not pretend to be a perfect one. It is 12′ wide by 8′ high, is composed of layers of plates supported by horizontal girders and vertical struts, and may be strengthened to any extent by simply adding extra plates to it. One that was tried, was struck by ten rounds from our 9-inch, 10-inch, and the 15-inch American gun, with charges representing a range of 400 yards, and all these shots failed to get through it.

(I may mention, in passing, that the battery of the "Hercules," at present our strongest iron-clad, can be pierced by the 9-inch gun at 1,400 yards).

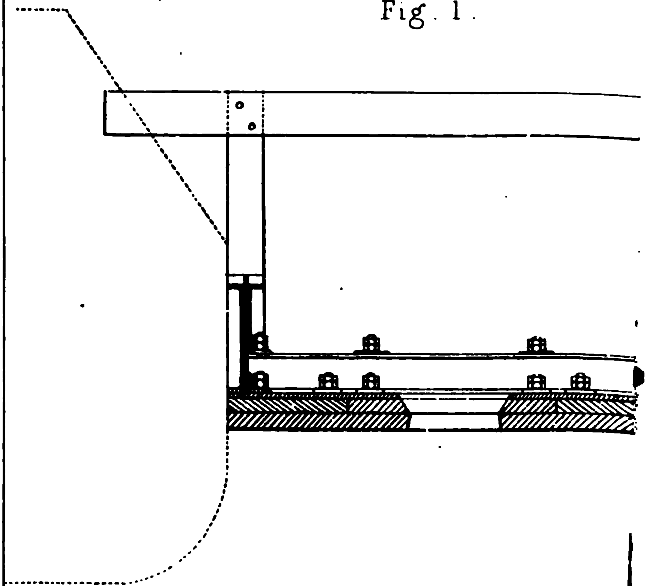
Several different kinds of shields have been proposed, besides those I have referred to. Shields proposed by Captain (now Lieutenant-Colonel) Inglis, R.E., which consisted of "planks," or narrow plates of iron crossing one another, gave very good results with blunt-headed projectiles; but the numerous joints and the rows of bolt-holes in the centres of the planks, render it undesirable to use planks for *outer* armour.

Another shield proposed by Lieutenant-Colonel Inglis consists of layers of plates in a curved form, as shown in this model.

Here are various other forms of shields, proposed by Lieut.-Col. Inglis, the designs of which were prepared to show that in proportion as iron is used in large masses, the cost of the shield is increased.

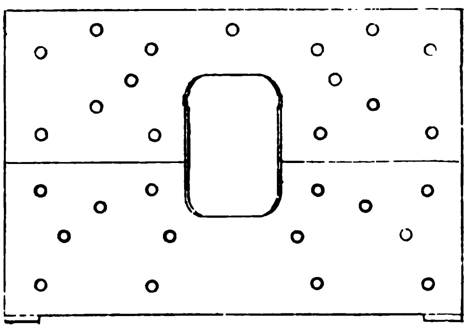
A shield has been proposed by Messrs. Cammel and Company, of Sheffield, with a view of getting rid of bolts. This is accomplished by fixing together two layers of thick plates by means of dovetail pro-

Fig. 1.



SECTIONAL PLAN THRO' EMBR

Fig 2



FRONT ELEVATION.

V

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J. Jo

sections, or one layer fitting into corresponding grooves in the other. This shield cannot, however, be strengthed if desired at any time after it has been completed.

The Millwall shield, designed by Mr. Hughes, Manager at the Millwall Iron Works, consists of armour-plates of any required thickness, placed on a backing of large bridge rails, or "hollow-stringers," which are riveted to an inner thin plate; the whole is bolted together with through bolts, and may be strengthened behind by girders. The intervals between the bridge rails in the experimental shield on this principal, which is now at Shoeburyness, and which I expect will give a good resistance, are filled with wood.

A shield designed for forts by Mr. Chalmers, consisted of 4-inch armour-plates resting on thin plates on edge, 8 inches deep, with 2-inch plates behind, further supported by 6 inches of teak, with horizontal iron-stringers, and having an inner skin of 1-inch plate. This was tried at Shoeburyness, and stood a good battering; but the embrazure in this shield only allowed 36° lateral range to the gun behind it. And in all cases of deep shields, where wood backing is introduced, the splay of the port, which should be about 70°, considerably reduces the resistance of a large surface of the shield. This makes it desirable so to construct a shield as to obtain the greatest resistance with little depth.

"*Laminated*" *Shields.*

Two shields of laminated iron, *i.e.*, a number of thin plates riveted together, were tried by the Iron-plate Committee some years ago at Shoeburyness, but failed. *Thin* plates placed together, offer only a succession of low resisting powers. The case is, however, very different with layers of *thick* armour, crossing each other so as to break joint effectually. These give very good resistances. There has been much misconception on this point. A law was supposed to exist, that the resistance of several plates together was only equal to the sum of the squares of their thicknesses; *i.e.*, the resistance of two 5-inch plates would on this assumption be 50, whilst that of one 10-inch plate would be 100.

The fact, however, is not so.

Experiments have shown that the resistances to penetration of thick solid plates of iron are not so much greater than those of an equal thickness made up of several layers of comparatively thick plates. For instance, the proportions between the resistances of 7 inches of iron when disposed in 1, 2, or 3 layers, are as 61, 57, 52, respectively.

In another experiment, two 5-inch plates gave a resistance equal to a solid 10-inch plate. While yesterday at Shoeburyness a 12-inch Palliser shell penetrated the solid 15-inch plate 12·3 inches, and broke the plate in two, the same shell just penetrated the three thicknesses of 5-inch plates. The Rodman gun, with a charge equal to 100 lbs. of American powder merely makes an indentation a few inches deep both in the solid plate and in the three layers. The result of the firing, by the way, effectually shows the vastly superior powers of our rifle guns over those of the American gun.

The slight superiority of the solid 15-inch plate over the three layers of 5 inches is not compensated for by the difficulties of construction which the use of 15-inch plates would create. In the three layers, the weakness caused by joints can be nearly uniformly distributed over the surface, whereas there are lines of greater weakness at the joints of the 15-inch plates. The method of connecting three layers and of attaching them to the supports by bolts is perfectly successful, but it is doubtful whether 15-inch plates can be properly connected and attached to such supports.

Experiments now in progress at Shoeburyness, with reference to Outer Walls of Forts.

I will now make a few remarks with reference to the outer walls of forts, whether when made wholly of iron, or of masonry and iron combined.

We have a specimen of each now under trial at Shoeburyness.

One which represents a section of a design for the Plymouth Breakwater Fort (Figs. 3, 4, pl. xxxvi) has the front wall separate from the front piers, by which the roof is carried. In the other, the front piers of the work are plated.

In the first, two-thirds of the iron wall are composed of 15 inches of iron in 3 plates, each 5 inches thick; about one-third of 20 inches of iron in 4 thicknesses. The iron wall rests against iron uprights, which are fixed into a plate at the bottom, and on the top, rest against the arches of the work, to which they are attached by a plate running round the work, which is oval. The advantage of this kind of structure is, that it can easily be added to by applying an extra plate, and the plates breaking joint, form in this respect a good constructional arrangement. The ports in it are also easily formed by merely cutting pieces out of the plates.

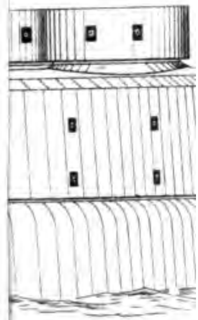
Whilst the experiments now being carried on are incomplete, it would be premature were I to state any decided opinion as to the best form of shield and the best form of iron wall for forts.

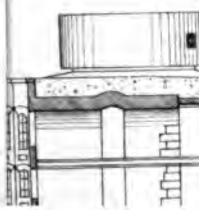
I may, however, say, as regards the iron-work of the Plymouth Breakwater Fort, that the late experiments show that, subject to certain modifications which can easily be made, and which had already received consideration, it would have—even if it has not for all practical purposes *now*—a power of resistance sufficient to defy any possible naval attack.

In the other specimen,* which is just about to undergo trial, but which does not represent any particular fort, the piers of the work are of inexpensive masonry (brickwork in cement) cased with thin iron; the wall between the piers is of Portland cement concrete, also cased with iron, and strengthened by iron cellular compartments.

The armour consists of various combinations, with a view of trying whether solid armour or cellular armour is preferable, and, if the latter, what kind of cellular arrangement is best.

* The diagram of this specimen has not been engraved.—W.D.J.





The port is strengthened by large vertical iron beams fixed strongly to horizontal iron beams built into the work.

The system I refer to, in which the walls are cased in iron and plated, should not be confounded with stone walls uncased, and only plated on the front. In the latter case, the plates are of little use, as was shown by experiments in America; but when the masonry is confined, and cannot get away on the armour being struck, it adds greatly to the resistance.

Personally, I now incline to the opinion that a backed wall is preferable to an unbacked one, and that, on account of the possibility of wood being deteriorated when the work is required to resist attack, inexpensive masonry or concrete enclosed in iron is preferable. Experiment has, moreover, shown that the more rigid backing affords greater resistance, and though, in the application of this method, unforeseen difficulties might arise from chemical action setting in between the iron and concrete, or from the necessarily small intervals between the girders making their connection imperfect, yet it is not improbable that these difficulties may be overcome. If so, this system may perhaps be economically employed for reducing the thickness of armour in cases where continuous iron cover of great extent is required.

Another advantage attaching to this system would be that any work so constructed might be completed with the exception of the armour (the most expensive part of the work). This might be added at any future time, and at moderately short notice, due provision being made in the erection of the backing for the bolt-holes necessary for the attachment of the armour plate, as has been done in the case of the basements of the Spithead Forts.

The section (Fig. 2, pl. xxxvi) shows the iron-fronted casemates of one of these works, raised upon a thick and massive bed of masonry, in which holes for bolts are left, so that the substructure of the fort may be covered with iron-armour plates, should it ever be deemed necessary to provide such an increase of strength.

The elevation of the same work is shown in the diagram (Fig. 1, plate xxxvi). The battery of this fort consists of 49 guns in two tiers of casemates, wholly iron-plated, with 10 guns in 5 iron turrets on the top. The guns in the casemates will be 400-pounders, and those in the turrets 600-pounders. The weight of metal then that can be delivered in a single round from all the guns would be about 25,600 lbs., while the weight that could be thrown in a single round from all the guns, which are seen in the elevation now before you (Fig. 1, plate xxxvi) would be 14,400 lbs.

The construction of the outer wall of the casemates will be such as the experiments now being conducted at Shoeburyness may show to be necessary.

Degree of Strength required for Outer Walls of Forts.

Having now referred to several different kinds of structures applicable for coast batteries, I will advert shortly to points bearing on the degree of strength required for the outer walls of forts.

In experiments at Shoeburyness, the fort is treated as a helpless

object, whereas the fact is, that it is able to inflict far greater damage upon its assailant than the latter can inflict upon it; whilst it will hit the assailant nearly every time, the chances of the assailant hitting it more than once on the same spot are small. Further, one shot may send a ship to the bottom, whilst the fire from the ship during action is more or less inaccurate. There is no instance that I know of, of a fort ever having been breached by a ship in a naval action.

In all the cases in which forts were breached during the late civil war in America, the attack was by batteries on land, from which fire can be directed leisurely, and with a precision that is unattainable in a naval attack. In the cases of Fort Sumter, Charleston,—Fort Morgan, Mobile,—Fort Pulaski, Savannah, which are sometimes cited as instances of successful attack on masonry forts, the attacks which were successful were all from land batteries, and the forts were only thin brick structures.

Fort Sumter, at Charleston, was in great part only five feet thick, and nowhere more than eleven feet thick, the most powerful guns in it were two seven-inch pieces, but it beat off a fleet consisting of eight turreted ships (monitors) and one broadside iron-clad of 16 guns, armed with 15-inch and 11-inch American guns. One vessel, the "Keokuk," sank after the action, owing to the effects of the fire from the fort.

Many say that granite casemates with iron embrasures will not stand naval attack; but the experience of men like General Ripley, who commanded in the defence of Charleston against the attack of the Federal iron-clads, and with whom I have had the advantage of conferring on the subject, and the recent examples from the American Civil War, considered in connection with our own experiments, do not, in my judgment, so far as our present information goes, bear out this view. Our granite casemates with iron shields at the embrasures are certainly as capable of resisting the guns of the present day, as Fort Sumter was, the American 15-inch and 11-inch guns of 1863.

General Barnard, one of the ablest Officers of the American Engineers, discussing this question in 1864, writes thus:—

"I readily admit that some very ugly scars may be made upon the "surface of our handsome granite walls, but am yet of the opinion "that, so long as the embrasure and its surroundings are made secure "by iron, nothing an iron-clad can do, armed with the most formidable "guns ever yet known to have been put afloat, will seriously impair "the offensive powers of the fort, in the limited time the fleet can "maintain the contest.

"In this aspect of the case, I do not yet anticipate any extensive "substitution of iron for masonry, nor much further use of iron for the "protection of masonry than may be necessary to give perfect security "to the embrasures. Behind masonry walls, having embrasures thus "secured, and under masonry casemates, we can use guns of the most "formidable power, such as the 200- and 300-pounder rifled, and the "10-inch and 13-inch smooth-bore, and the importance of the case"mate (better made of masonry than any other material) for the pro-

" tection of gun and gunners, has been amply demonstrated by events " of this war."

Bearing in mind these views, there are many cases in which granite forts with iron shields at the embrasures will, if powerfully armed, afford the required protection. Where, however, a work is entirely isolated, and from its position specially liable to a concentrated fire, or where the foundations being in deep water are very limited in extent, it is no doubt desirable that the cover in front of the guns should be wholly iron-plated, as, for instance, in the case of the Spithead Forts.

But whatever material is used in the construction of a fort, and whatever may be the amount of iron employed in it, the question of the power of forts and batteries is as much one of the power of the gun,—and, I must add, of the submarine mine protected *by* the gun,—as of the power of resistance of the structure by which the gun is covered.

Now, I do not think the trials to which the Plymouth Breakwater target has just been subjected, at all represent these circumstances. In these, the power of the guns in the fort was not considered, and the science of submarine mining was ignored.

It is often said, " What is the use of your forts; when they are built, an enemy won't go near them." Probably not. The object of fortifying certain places is to *prevent* an enemy going near them. The observation, however, is not very consistent with the statement that the enemy will go up within 200 yards of a fort, and smash it.

Every advance that can take place in the power of the gun, will enable it to pierce ships, and so to protect torpedoes, at a greater distance, and is more in favour of the fort than of the ship.

It was not easy to get through the Plymouth target with the most powerful gun at its weakest part, at 200 yards.

On the other hand, as I before stated, the Hercules battery could be silenced with 9-inch guns at 1,400 yards, and at a much greater distance with other guns.

These are reasons which I maintain affect the question of the degree of strength required for the outer walls of forts. Whilst, however, thus stating an individual opinion, the views of the majority appear to be in the direction of absolute invulnerability at any price. If money is no object, difficulty vanishes. It will be satisfactory to know that there is no difficulty in making the Plymouth fort, or any other of our iron forts, of any strength that may be desired.

Meanwhile, I beg permission to say, that having visited most of the works of fortification in America, and having seen several on the continent; being, moreover, aware of what is being done by other nations, I unhesitatingly assert that the forts produced by our engineers are superior to those of any other nation, and that, armed with the powerful guns that are produced by the sister corps—the Royal Artillery—they will give a good account of any enemy by which they may be attacked.

NOTE.—This lecture was delivered just after the experiments at Shoeburyness on the target representing a section of the Plymouth Breakwater Fort.—W.F.D.J.

The Journal

OF THE

Royal United Service Institution.

VOL. XII. 1869. APPENDIX.

PROCEEDINGS OF THE THIRTY-EIGHTH ANNIVERSARY MEETING.

THE THIRTY-EIGHTH ANNIVERSARY MEETING of the Members was held in the Theatre of the Institution, on Saturday, the 6th March, 1869.

The Right Hon. H. CULLING-EARDLEY CHILDERS, M.P., First Lord of the Admiralty, in the Chair.

I. The Secretary read the Notice convening the Meeting.

II. The Minutes of the Proceedings of the Thirty-seventh Anniversary Meeting were read.

III. The Annual Report of the Council was read as follows:

1. THE COUNCIL have the pleasure of submitting the Thirty-eighth Annual Report.

MEMBERS.

2. One hundred and eighty-eight Members joined the Institution during the year 1868, being an increase of forty-seven on the number of the previous year. The losses by death, however, amounting to one hundred and nine, were greater than for several years past. The number of withdrawals was sixty-eight, and the names of twenty-two have been struck off the list (their subscriptions having been unpaid for three years and upwards). The loss on the year, therefore, amounted to eleven.

A detailed statement of the changes in the list of Members, and a tabular analysis of the past and present state of the Institution, will be found on pages 7 and 8 (x and xi of Appendix).

FINANCE.

3. The usual Abstract of the Yearly Accounts, as audited on the 9th February, will be found on the following page:—

GENERAL ABSTRACT OF THE ACCOUNTS OF THE ROYAL UNITED SERVICE INSTITUTION, FROM 1st JANUARY to 31st DECEMBER, 1868.

EXPENDITURE.

	£ s. d.	£ s. d.
Secretary's Salary ...		250 0 0
Ditto Lodging Allowance ...		50 0 0
Librarian's Salary ...		95 16 8
Accountant's ditto...		100 0 0
Clerk's ditto ...		62 0 0
Servants' Wages ...		387 17 9
Ditto Clothing...		46 2 0
Insurance...		20 5 0
Ground Rent ...		200 7 4
Fuel ...		63 9 0
Lighting ...		41 13 7
Annuity to John Pitt ...		20 0 0
Assessed Taxes ...		86 4 9
Income Tax ...		4 3 4
Parish and Water Rates ...		167 1 8
Artificers ...		165 11 6
Museum ...		184 4 10
Library ...		119 1 6
Topographical Room ...		3 8 6
Advertisements ...		40 17 9
Printing Circulars and Stationery ...		88 14 5
Lectures ...		26 13 5
Journals ...		631 8 4
Postage { Journals ...	119 18 4	
Postage { Letters ...	42 16 2	
		162 14 6
Printing Annual Report and List of Members ...		88 1 6
Expenses consequent on the Coin Robbery ...		15 8 0
Miscellaneous ...		38 15 3
Balance of Petty Cash returned to Bankers ...		7 3 4
Total Expenditure ...		£3,167 3 11
Cash repaid to Agents ...		12 0 0
Charges from ditto ...		2 14 9
Invested in purchase of £663 17s. 6d. Stock ...		620 0 0
£1,000 Exchequer Bills, transferred from Messrs. Drummond, at par ...		1,004 12 0
Balance at Bankers, 31st December, 1868 { Income ...	180 19 10	
Balance at Bankers, 31st December, 1868 { Life ...	17 0 0	
		197 19 10
Total ...		£5,004 10 6

RECEIPTS.

	£ s. d.	£ s. d.
Balance at Bankers, 31st December, 1867 ...		53 6 11
Annual Subscriptions, at 10s., for 1868 ...	574 13 6	
" " above ...	1,832 0 6	
" " arrears ...	30 0 0	
" " advance ...	9 10 0	
		2,446 4 0
Entrance Fees ...		184 0 0
Donations ...		8 7 0
Dividends ...		192 17 3
6 months' Interest on £1,000 Exchequer Bills ...		9 15 0
Sale of Journals ...		93 9 1
" Waterloo Pamphlets ...		0 6 0
£1,000 Exchequer Bills, transferred from Messrs. Drummond, at par ...		1,001 16 11
Government Grant ...		600 0 0
Cash found on the Prisoner (Coin Robbery) ...		76 10 0
Balance of Cash for purchase of Breech-loaders, returned to Bankers ...		33 15 0
" Petty Cash returned to Bankers ...		7 3 4
		£4,707 10 6
Life Subscriptions, received during 1868 ...		297 0 0
Total ...		£5,004 10 6

London, 9th February, 1869.
Examined and found correct.

H. F. DOWNES.
J. E. A. DOLBY.
THOS. SMITH.

GEO, FELSTEAD, Accountant.

Estimate of Receipts and Expenditure for the Year 1869.

Expenditure.

	£	s.	d.
Secretary's Salary and Lodging allowance	300	0	0
Librarian's Salary ..	100	0	0
Accountant's „	100	0	0
Clerk's „	62	0	0
Servants' Wages	400	0	0
Ditto Clothing ..	60	0	0
Insurance	20	5	0
Fuel	60	0	0
Lighting	40	0	0
Ground Rent	205	0	0
Annuity to John Pitt ..	20	0	0
Assessed Taxes & Income Tax	90	0	0
Parish and Water Rates	100	0	0
Artificers, Repairs, &c. ..	170	0	0
Library and Topographical Department	170	0	0
Journals	850	0	0
Postage thereof	150	0	0
Museum	180	0	0
Advertisements	50	0	0
Lectures	50	0	0
Printing Annual Report and List of Members ..	90	0	0
Printing Circulars & Stationery	100	0	0
Postage	50	0	0
Sundries	50	0	0
	3,467	5	0
Balance ..	133	14	10
Total.. ..	£3,600	19	10

Receipts.

	£	s.	d.	£	s.	d.
Balance at Bankers 31st Dec., 1868				180	19	10
Annual Subscriptions:						
At 10s. ..	560	0	0			
Above ..	1,840	0	0			
				2,400	0	0
Entrance Fees				150	0	0
Dividends				200	0	0
Sale of Journals				70	0	0
Government Grant ..				600	0	0
Total.. ..				£3,600	19	10

Life Subscriptions.

4. The Life Subscriptions received during the year 1868, amounted to £297. Of this sum, £280, together with the balance of £53 6*s*. 11*d*. from the previous year, have been duly invested in Three per Cent. Consols.

Capital Account.

5. The funded property of the Institution, on the 1st January, 1868, was £5,732 11*s*. 2*d*. £663 17*s*. 6*d*. (including Life Subscriptions as above), were invested during the year, making the total on the 1st January, 1869, £6,396 8*s*. 8*d*.

LEASE OF THE PREMISES.

6. The Council regret that they are still unable to give the Members any definite information with respect to the tenure of these premises.

They have been in communication with the authorities, and placed before them the claims of the Institution.

The present Chancellor of the Exchequer informed a deputation of the Council, that he could give no decided answer until the future site of the public offices had been determined.

LECTURES AND JOURNAL.

7. The Lectures, and Papers read at the Evening Meetings, during the past Session, were, in the variety and importance of the subjects, fully equal to those of former years.

The Council are gratified to find that the Journal maintains its high reputation both at home and abroad.

They tender their best thanks to those gentlemen who have furnished so much valuable professional information to the Members of the Institution and all persons interested in the progress of Naval and Military Science.

During the year, an Index of the Subjects contained in the first ten Volumes of the Journal has been prepared and issued to the Members. The Council believe that this Index will be found of great value.

LIBRARY.

8. In selecting books for purchase, no new work relating to Naval and Military Science or History has, it is believed, been overlooked.

Among the works that have been presented to the Institution are the following:—

By the AUSTRIAN Government—
Three Volumes of *The War of* 1866, with Plans.

By the BELGIAN Minister-at-War—
The Triangulation of the Kingdom of Belgium, Books 1, 2, and 3, containing, among other matter, the Verification of the Base.

By the ITALIAN Minister-at-War—
The *Giornale Militare* for 1867, and the *Annuario Militare* for 1868.

By the RUSSIAN Government—
Eight Numbers of their *Engineering Journal* and Two Numbers of their *Military Journal* for 1867.

By the SWISS Government—
The Field Exercise for the Troops of the Swiss Confederation; also a copy of the *Report of the Federal Military Department on its Administration in* 1867.

By Lieut.-Colonel Wright, of the PRUSSIAN Army—
Three Numbers of the *Prussian Account of the Campaign of* 1866.

And by The ROYAL INSTITUTION of Great Britain—
156 Volumes of *Army Lists*, of which twenty were retained to supply deficiencies in the Library, and the remainder presented to the Prince Consort's Library at Aldershot.

The exchange of Journals with Foreign Governments, and with various scientific Societies in this country, has been continued.

The Library now contains 14,100 Volumes.

Topographical Department.

9. The Bavarian Minister at War has presented 25 Sheets of a Map of the South West of Germany.

The Secretaries of State for War and for India have presented Views of Magdala; Maps of Abyssinia; Photographs of Breech-loaders, of the 7-pounder Mountain Mule-train Guns for Abyssinia, of sundry Targets, and of Moncrieff's Gun-carriage; also Lithographic Plates of the Manufacturing Departments of the Royal Arsenal at Woolwich, &c.

Lord Napier of Magdala has presented fourteen Photographs taken in Abyssinia.

Museum.

10. The various additions to the Library and the Museum, both by presentation and purchase, will be found duly recorded in the Appendix to Vol. XII. of the Journal. To the following, however, the Council desire to draw the attention of the Members, viz.:—

1stly. The Pocket-glass of Napoleon I., used by him at the Battle of Waterloo, and given by Sir James Wylie, Bart., (Physician-General to the Emperor Alexander I. of Russia) to Hugh Duke of Northumberland. This glass was presented to the Institution, through Colonel North, M.P., by Eleanor Duchess Dowager of Northumberland,.

2ndly. Seven elaborate Models, (horizontal scale $\frac{1}{15000}$) constructed from the Maps of the Prussian Staff, of some of the more remarkable Battle-fields of the Campaign of 1866. Of these Models, six were purchased on behalf of the Institution, by Colonel Walker, Military Attaché, Berlin, of Mons. H. Walger, the eminent modeller of that city. The seventh was presented by Mons. Walger.

The Council are not aware that any other Institution in this country possesses similar Models.

3rdly. The following Breech-loading Rifles, presented by the inventors, viz.:—The Carter and Edwards; the Rutley; the Berdan; and the Wilson. These form valuable additions to the already large collection in the Armoury.

The thanks of the Council have been tendered to the Secretaries of State for War and for India, to the Lords of the Admiralty, and to the various Donors for their respective contributions to the Institution.

ROBBERY OF COINS.

11. The Council regret to announce that it was discovered in September last, that a number of coins had been stolen from the Library by a Member of the Institution. These coins formed part of a collection bequeathed to the Institution some years since by the late Walter Hawkins, Esq., F.S.A. A considerable number of them, and a portion of the money realised by the sale of the remainder, have been recovered. The culprit, on being brought up for trial at the Middlesex Sessions, pleaded guilty, and was sentenced to five years' penal servitude. A strict investigation into all the circumstances of the case was instituted by the Council. The office of Assistant Secretary and Librarian which became vacant, has been filled up by the provisional appointment of Captain Humphry, late Royal Engineers (Bengal).

VICE-PATRONS.

12. The Council have had the pleasure of electing his Excellency Lieutenant-General Lord Napier, of Magdala, G.C.B., G.C.S.I., a Vice-Patron of the Institution.

The Principal Secretaries of State, under the present Government, have become *ex officio* Vice-Patrons.

It is with regret that the Council record the death of Field Marshal the Right Hon. Sir Edward Blakeney, G.C.B., G.C.H., late Governor of the Royal Hospital, Chelsea, and a Vice-Patron of this Institution. It would be impossible, within the limits of this Report, to record the varied and brilliant services of this distinguished Officer.

HONORARY MEMBERS.

13. The Council have elected several Officers of Foreign Services, Honorary Members of the Institution during their stay in this country.

CORRESPONDING MEMBERS OF COUNCIL.

14. On the 1st January, 1869, there were 279 Corresponding Members of Council, as compared with 213 on the 1st January, 1868.

The Council take the opportunity of the circulation of this Report to thank their Corresponding Members for their services.

CONCLUSION.

The Council, in conclusion, congratulate the Members of the Institution on the state of its finances and on its general efficiency. They desire, however, to express an earnest hope that the Members will not relax their efforts to obtain for the Institution a more general support from the Officers of the Naval and Military Services.

Captain INGLEFIELD, R.N., F.R.S.—

I beg to propose—

"That the Report now read be adopted and printed for circulation amongst the Members."

When I came into this room I was asked to move this resolution. I am, therefore, quite unprepared to follow up the motion by making such remarks as I feel many Naval and Military Officers would be able to do. I must, therefore, ask you to excuse me if I say but little more than, that I in common with many Naval Officers, have derived great benefit from this Institution, from being able to consult the records kept in our library, and also from the opportunities which are here afforded to Officers of bringing forward their inventions and improvements, and having them fairly discussed. There are gentlemen here present who will doubtless be able to speak more fully as to the merits of this Institution than I can do. I have only therefore to move "that the Report be adopted and printed for circulation amongst the Members."

The Motion having been Seconded by Colonel STEPNEY, M.P., was then put from the Chair and carried unanimously.

The names of the eight Members retiring from the Council by rotation, were read as follows:—

W. STIRLING LACON, Esq.
Captain A. C. TUPPER.
Major-General J. T. BOILEAU, R.E., F.R.S.
Colonel H. HUME, C.B.
Rear-Admiral A. P. RYDER.
Vice-Admiral G. GOLDSMITH, C.B.
Rear-Admiral OMMANNEY, C.B., F.R.S.
Major-General Sir VINCENT EYRE, K.C.S.I., C.B.

Admiral Sir GEORGE SARTORIUS, K.C.B., Vice-Admiral of the United Kingdom—

I beg to propose "that the thanks of this Meeting be given to the Members of the Council who retire by rotation, and that the following Members be elected to fill the vacancies":—

W. STIRLING LACON, Esq.
Captain A. C. TUPPER.
Rear-Admiral OMMANNEY, C.B., F.R.S.
} For Re-election.

Rear-Admiral the Right Hon. Lord FREDERICK H. KERR.
Captain H. W. TYLER.
Lieut.-Colonel The Hon. E. LEGGE, Coldstream Guards.
Rear-Admiral EDWARD S. SOTHEBY, C.B.
Lieut.-Colonel C. B. EWART, R.E.

And that the following names be adopted from which to select in the event of vacancies occurring in the Council:—

Major-General J. ST. GEORGE, C.B.
Captain W. HORTON, R.N.
Colonel LANE FOX, late Grenadier Guards.
Lieut.-Colonel J. H. LE COUTEUR, late Coldstream Guards.

I have little more to say in proposing this vote of thanks, than that gentlemen have nothing to do but to go round this establishment to see how well deserved are the thanks which we propose to give to the Members who retire, and how thankful we ought to be also to the permanent officers who have so materially contributed to place this excellent and interesting establishment upon its present sound and satisfactory footing. I am glad to say that three of my sons have joined it.

General GASCOIGNE—

I beg to second the resolution. My task is a very easy one, as in the first place

the Vice-Admiral has taken the wind out of my sails if I had anything to say upon the subject. There is no doubt that the resolution will be most acceptable, and I have great pleasure in seconding it.

The Motion was then put from the Chair and carried unanimously.

Captain HORTON, R.N.—

I beg to move the next resolution, which requires no recommendation at my hands. The duties of the Auditors are so important and so well performed that I have nothing to do but to propose the adoption of this resolution, viz.:—

"That the thanks of this Meeting be given to the Auditors for their valuable services, and that the following gentlemen be elected Auditors for the ensuing year:—

THOMAS SMITH, Esq., for Re-election.
Captain J. E. DOLBY.
F. E. DOWNES, Esq."

The Resolution having been Seconded by Major FARRELL, was put from the Chair and carried unanimously.

Rear-Admiral Sir F. NICOLSON, Bart., C.B.—

The first paragraph of the second section of our Bye-laws provides that certain functionaries shall be elected *without ballot*, but there is no provision made for their election by being balloted for, in the event of their quitting their offices. It is, therefore, proposed to add to the second paragraph of that section the words, "Ex-Governors of Colonies and Dependencies," who are to be elected by ballot. The paragraph already provides that retired officers shall be so elected, and it must have been a mere omission that Governors of Colonies and Dependencies who are elected without ballot while they hold their offices, should not have been put into that paragraph, in order that they might, after quitting the colonies and coming home, be elected by ballot. We have already had several instances of men of high distinction anxious to become Members. This proposal is to enable them, in a formal and regular manner, to be elected by ballot. The resolution stands thus—

"That in section 2, paragraph 2, of the Bye-laws, the words 'Ex-Governors of Colonies and Dependencies' be inserted before the words 'Retired Officers.'"

The Resolution having been Seconded by Lieutenant-Colonel FLETCHER, Scots Fusilier Guards, was put from the Chair and carried unanimously.

The CHAIRMAN then announced that the business of the Meeting was concluded.

The Chair having been taken by Rear-Admiral Sir JOHN HAY, Bart, M.P.,

Admiral Sir HENRY CODRINGTON said—

I have to propose a vote of thanks to the Right Hon. Hugh Childers, for his kindness in taking the Chair on this occasion. We must all feel that it is a great object to us that this Institution should be thoroughly known to those who are at the heads of Departments. There are two reasons for this. In the first place it is a good thing for us, and the more publicity we have the better. That object cannot be better attained than by those who are best acquainted with the Services of the country, coming here and seeing what we are, what our arrangements are, and whether we are really benefiting the Military and Naval services, and are doing our duty to the public as well as to the Members of the Institution. The oftener these gentlemen can come and take part in our proceedings, the better for us. We

are naturally very anxious that they should see everything and learn everything belonging to us. In the second place, we may also say that the advantages are not all one-sided. We feel that as an Institution we are doing them good. We enable them to gain all the information that we can afford them on naval and military subjects. Moreover, as these gentlemen really have not the time to investigate all new inventions, they are enabled to see here the results of many of the new inventions before the public. Here everything is well ventilated, and those who hold high official positions, without having their time too much occupied, can see those inventions for themselves, they can also ascertain what has been the decision of our brother officers on them, and then make up their minds as to whether any particular invention is worth being tried at the public expense or not. We must always remember that we are doing our duty towards the Queen and Government—whatever that Government may be—as well as to the general public. As I have said before, it is not often that gentlemen holding high official positions can find time to leave their duties, which are generally of a very absorbing character, to attend to our proceedings here; we are, therefore, the more grateful when we can secure their services. I am sure that the Meeting will feel with me, that we owe a debt of gratitude to Mr. Childers and other gentlemen holding similar positions for coming amongst us.

General STANHOPE—

I have a very easy task in seconding the motion which has been made by my gallant friend. We ought indeed to be truly grateful to the right hon. gentleman for taking the Chair on this occasion, and devoting a portion of his valuable time to attending to the interests of this Institution.

The Motion was carried with acclamation.

The Right Hon. HUGH CHILDERS—

Sir John Hay and Gentlemen, I can assure you, that when I was asked a short time ago if I would take the Chair on this occasion, I felt not only great pleasure but very great honor in that invitation. The connection between the Government and an Institution of this kind, ought to be of the most friendly, and I may say, of the most cordial character; and so far as it in me lies in any way to promote that object, you may on all occasions be quite certain of my best endeavours to do so. Gentlemen, I look upon this Institution—if I may be allowed to say so—as a sort of neutral ground of professional inquiry connected with the two Services. We have political inquiries in the two Houses of Parliament; and we have departmental inquiries at the War Office and at the Admiralty; and you all know that those inquiries and researches cannot be altogether dissociated from questions of pure politics or questions of administration. In this hall and under the auspices of this Society, investigations of the same kind proceed, into which questions of mere party feeling or of administration cannot—and I hope never will—enter in the slightest degree. No one who has had an opportunity, as I have, of perusing the most valuable papers that have been read here, which bear directly upon questions dealt with in Parliament and in the Departments, can fail to be greatly benefited; and I believe that what is done here, influences in a very remarkable degree many things which are done elsewhere. As to the collections of the Society and the objects which those who walk round these rooms observe, there can be no doubt that they are of very great interest. They bring into a focus in a remarkably clear and satisfactory manner, things which no doubt are to be found elsewhere, but scattered over many places, some of them with very inferior arrangements. Therefore, on that ground also, I think this Society ought to receive the best thanks of Her Majesty's Government; and it is satisfactory to me to know that it receives those thanks not only in words, but also in the practical shape which it will be my duty on Monday to recommend to the House of Commons. Gentlemen, I know you will excuse me if I do not say more. I never was present at a meeting where the business was got through in so satisfactory a manner, and I shall not be the person to violate the rule which you seem to have laid down for the conduct of your affairs. Allow me to

say again in conclusion that I thank you very much for the honor which you have done me, and I feel that I shall derive very great benefit from the assistance of your Society.

General Fox—

The Right Hon. Gentleman has been kind enough to say that he will assist us in any way he can. May I request him—I am sure we shall all agree in that request—that he will urge upon his colleague, the Right Hon. the Chancellor of the Exchequer, and also upon Mr. Layard to endeavour to procure us a site as soon as possible.

STATEMENT OF CHANGES AMONG THE MEMBERS SINCE 1ST JANUARY, 1868.

			Life.	Annual.	Total.
Number of Members, 31st December, 1867 ..			883	2,940	3,823
„ „ joined during 1868 ..			24	164	188
			907	3,104	4,011
Changed from Annual to Life			+12	−12	
			919	3,092	
	Life.	Annual.			
Deduct—Deaths during 1868..	28	81			
Withdrawals ..		68			
Struck off		22			
			28	171	199
Number of Members on 1st January, 1869 ..			891	2,921	3,812

Tabular Analysis of the State of the Institution,

To 31st of December, 1868.

Year. 1st Jan. to 31st Dec.	Annual Subs. received.	Entrance Fees.	Income (from all sources).*	Life Subs. received.	Amount of Stock.	Invested in the purchase of Books, &c.	No. of Vols. in Library.	No. of Members on the 31st Dec.	Number of Visitors
	£	£	£	£	£	£			
1831	654	..	654	1,194	..	..	..	1,437	..
1832	1,146	..	1,146	973	..	..	..	2,699	..
1833	1,405	..	1,450	692	..	..	..	3,341	..
1834	1,500	..	1,549	583	1,100	..	..	3,748	13,376
1835	1,480	..	1,574	366	2,430	40	..	4,155	8,537
1836	1,570	..	1,682	330	3,747	45	..	4,069	8,521
1837	1,549	..	1,747	222	4,747	180	..	4,164	10,907
1838	1,462	..	1,634	230	5,500	246	..	4,175	15,788
1839	1,399	..	1,565	168	5,500	292	..	4,186	16,248
1840	1,363	..	1,525	198	5,500	446	5,500	4,257	17,120
1841	1,450	..	1,643	186	6,000	243	5,850	4,243	19,421
1842	1,373	..	1,565	144	6,400	373	6,450	4,127	21,552
1843	1,299	..	1,494	140	6,700	237	7,000	4,078	27,056
1844	1,274	..	1,408	112	3,000	298	7,850	3,968	22,767
1845	1,313	..	1,466	228	1,500	127	8,100	3,988	21,627
1846	1,298	..	1,456	138	1,500	74	8,410	4,031	32,885
1847	1,314	74	1,502	132	1,700	37	..	4,017	38,699
1848	1,175	57	1,375	48	1,700	85	9,641	3,947	37,140
1849	1,176	72	1,375	84	1,150	58	..	3,970	33,333
1850	1,141	106	1,294	198	600	36	..	3,998	33,773
1851	1,136	131	1,292	66	666	34	10,150	3,188	52,173
1852	1,134	133	1,281	114	200	43	10,300	3,078	20,609
1853	1,243	319	1,684	264	528	41	10,420	3,251	25,952
1854	1,200	138	1,368	126	612	95	10,587	3,171	22,661
1855	1,159	107	1,289	120	653	55	10,780	3,131	14,778
1856	1,216	197	1,519	156	761	47	10,832	3,204	16,184
1857	1,258	176	1,937	78	1,038	40	10,960	3,168	12,755
1858	1,318	221	2,102	105	438	31	11,062	3,246	25,747
1859	1,526	195	2,277	512	946	70	11,320	3,344	28,739
1860	1,961	298	3,577	397	2,178	114	11,517	3,518	28,011
1861	2,122	305	2,899	266	2,846	99	11,812	3,689	23,296
1862	2,296	242	3,127	239	3,178	109	12,026	3,797	27,215
1863	2,379	218	3,100	405	3,583	143	12,296	3,847	18,150
1864	2,425	215	3,253	222	4,516	116	12,700	3,902	17,276
1865	2,435	154	3,467	235	4,804	137	13,000	3,895	18,253
1866	2,435	157	3,488	299	5,486	150	13,337	3,891	17,067
1867	2,431	141	3,467	208	5,732	140	13,800	3,823	17,211
1868	2,446	184	3,534	297	6,396	119	14,100	3,812	16,417

* Including Annual Subscriptions, Entrance Fees, Donations, Legacies, and Interest on Funded Property; and also the Grant from Government, commencing in 1857.

DONATIONS IN 1868.

Adams, Thomas, Capt. hp. 39th Regt., 2*l*.
Greenhill, Barclay, Major Vic. Rifle Volrs., 2*l*. 2*s*.
Smith, H. F., Major 1st Midx. Art. Volrs., 3*l*. 5*s*.
Fane, Charles G., Lieut. R.N., 1*l*.

NAMES OF MEMBERS

WHO JOINED THE INSTITUTION BETWEEN THE 29TH JUNE AND 31ST DECEMBER, 1868.

LIFE.

Napier of Magdala, His Excellency Lieut.-Gen., Lord, G.C.B., G.C.S.I., R.E., 9*l*.
Barton, Edward, Ensign 27th Regt.
Fane, Charles G., Lieut. R.N., 9*l*.
Carr, Henry J., Lieut. R.N., 9*l*.
Goodenough, F.A., Capt. late Calcutta Volrs., 9*l*.
Bates, C. Ellison, Capt. Bengal Staff Corps, 9*l*.
Justice, Philip, Lieut. 108th Regt., 9*l*.
Lendy, A. F., Capt. Royal South Midx. Mil., 9*l*.
Blackwood, Sir Francis, Bart., Commr. R.N., 9*l*.

ANNUAL.

Fitzgerald, Charles C. P., Lieut. R.N., 1*l*.
Williams, John, Ensign 1st W.I. Regt., 1*l*.
Steward, C. Branford, Lieut. 1st W.I. Regt., 1*l*.
Bale, John Edward, Lieut. 1st W.I. Regt., 1*l*.
Millington, Walter, Lieut. 3rd Essex Art. Volrs., 1*l*.
Vereker, Thomas George J., Major late 12th Regt., 1*l*.
Atkinson, Richard, Major 12th Regt., 1*l*.
Heasty, George B., Capt. Royal Marines L.I., 1*l*.
Close, Frederick, Capt. Roy. Art., 1*l*.
Turquand, W. M. Glyn, Capt. Cold. Gds., 1*l*.
Cassillis, Earl of, Lieut. Cold. Gds., 1*l*.
Campbell, Hugh, Commr. R.N., 1*l*.
Guinness, B. Lee Cornet R.H. Gds., 1*l*.
Colomb, J. R. C., Capt. Royal Marine Art., 1*l*.
Turnbull, J. R., Major 1st Royal Drags., 1*l*.
Montgomery, George S., Brig.-Gen. Bombay Army
Moray, J. C. D. S., Capt. 28th Bo. N.I.
Buller, Charles E., Lieut. Roy. Art.
Hatchell, George, Capt. 60th Royal Rifles, 1*l*.
Beckwith, Henry J., Capt. 53rd Regt., 1*l*.
King, Eyare, Lieut. 3rd W.I. Regt.
Edgcumbe, Piers, Lieut. 3rd W.I. Regt., 1*l*.
Cundell, J. P., Lieut. Roy. Art., 1*l*.
Parr, Thomas R., Capt. 1st Somerset Militia, 1*l*.
Cox, F. K., Capt. late 25th Regt. K.O. Borderers, 1*l*.
Hall, Basil S. de R., Capt. R.N., 1*l*.
Walker, Henry C., Lieut. R.N., 1*l*.
Baker, G. A. A., Capt. 6th Bengal Cavalry, 1*l*.
Shute, C. C., Colonel 4th Drag. Gds., 1*l*.
Gully, Philip, Lieut. 22nd Regt., 1*l*.
Molyneaux, W. C. F., Ensign 22nd Regt., 1*l*.
Crocker, Henry, M.D., 4th Inf., Hydrabad Contingent, 1*l*.
Dick, William, M.D., Dep. Insp.-Gen. of Hospitals, 1*l*.
Byrne, T. E., Capt. Roy. Art., 1*l*.
Durrant, Christopher R., Lieut., 4th K.O., 1*l*.
Philips, Alexander, Capt. R.N., 1*l*.
Stewart, John D. H., Lieut. 11th Hussars, 1*l*.
Hale, Joseph, Major-Gen., Colonel 103rd Royal Bombay Fusiliers, 1*l*.
Drew, F. B., Major 8th or King's, 1*l*.
McCrea, F. B.. Major 8th or King's, 1*l*.
Bridge, Cyprian A. G., Lieut. R.N., 1*l*.
Gibson, Robert, Capt. R.N., 1*l*.

Hogg, Adam, Lieut. 2nd Belooch. Regt., 1*l.*
Fraser, James, Col. late 72nd Highlanders, 1*l.*
Dawson, C. S., Major 3rd Buffs, 1*l.*
Hereford, Charles, Capt. 19th Regt., 1*l.*
Thuillier, H. E. L., Col. R.A., Surveyor-Gen., India, 1*l.*
Gordon, Cosmo, F. M., Lieut. R.N., 1*l*
Barrow, Knapp, Capt. Unatt. 27th Regt., 1*l.*
Hutchinson, R. R., Capt. 1st Tower Hamlets Rifle Volrs., 1*l.*
Warren, William, Lieut. 60th Royal Rifles, 1*l.*
Cruikshank, J. D., Lieut. Roy. Eng.
Humfrey, Fred., Capt. 2nd Belooch. Regt.
Geddes, W. L., Capt. 53rd Regt.
O'Hagan, James, Esq., late Department of Works, War Office, 1*l.*
Ommanney, Henry Mortlock, Lieut. R.N., 1*l.*
L'Aker, John, Capt. 1st London Eng. Volrs.
Jessop, Thomas, Lieut. 2nd R.N.B. Drags., 1*l.*
Malley, James, Lieut. 53rd Regt.
Baines, Frank, Lieut. 18th Hussars
Hooper, Fred. Charles, Lieut. 18th Hussars, 1*l.*
Blakeney, W. A. F., Lieut. 52nd Regt. L.I.
Biddulph, G. H. M., Ensign 52nd Regt. L.I.
Brownrigg, M. S., Lieut. 52nd Regt. L.I.
Barwell, W. B. B., Capt. 52nd Regt. L.I.
Jones, George Willoughby, Ensign 97th Regt., 1*l.*
Melville, P. Lawrence, Ensign 97th Regt., 1*l.*
Saunders, Arthur, Lieut. Roy. Art., 1*l.*
Greenhill, Barclay, Major Vic. Rifle Volrs., 1*l.*
Denny, D'Arcy A., Commr. R.N., 1*l.*
Basevi, C. E., Capt. Roy. Art., 1*l.*
Gamble, D. J., Colonel hp., 4th King's Own, 1*l.*
Corry, Hon. Henry W. L., Capt. Cold. Gds., 1*l.*
Bridgford, Robert, Lt.-Col. Manchester Rifle Volrs., 1*l.*
Ridgway, T. G., Esq., Army Agent, 1*l.*
Smith, H. F., Major 1st Midx. Art. Volrs., 1*l.*
Acland, W. D. A., Lieut. R.N., 1*l.*
Hornby, John, Lieut. Hon. Art. Coy., 1*l.*
Sylvester, J. J., Esq., M.A., F.R.S., Professor of Mathematics, Roy. Academy, Woolwich, 1*l.*
Skinner, G. B., Lieut. 15th Regt.
Bayly, George Cecil, Lieut. Roy. Art., 1*l.*
Phillips, Charles G., Capt. R.N., 1*l.*
Warren, William, Lieut. Roy. Art., 1*l.*

ADDITIONS TO THE LIBRARY AND MUSEUM DURING 1868.

LIBRARY.

BOOKS PRESENTED.

ADDRESS to H.R.H. the Duke of Clarence from several Naval Officers (Original). *General Fox.*

ADMIRALTY Catalogue of Charts, Plans, Views, and Sailing Directions. 8vo. London, 1868.

A HISTORY of the Royal Toxopholite Society, Edited by a Toxopholite. 8vo. 1867. *Anonymously.*

ALMANAC, Nautical, for 1872. 8vo. London, 1868. *Lords of the Admiralty.*

ANNUARIO Militare del regno d' Italia, for 1868. 8vo. *Italian Minister at War.*

ANSTRUTHER, P., Major-General. Description of an Instrument to facilitate the drawing of the Trajectory of any Ball, at any Elevation, with any Velocity. Pamph. 4to. 1868. *Captain Fishbourne, R.N., C.B.*

ARMY List, Official Annual, for 1868-69. *The Secretary of State for War.*

ARMY Lists, Annual, 40 vols. 8vo.
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